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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1974/47

PRE SURVEY REPORT
OFFICER BASIN AEROMAGNETIC SURVEY
W.A., 1974

by

D.H. Tucker

RESTRICTED.

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CONTENTS

ILLUSTRATIONS (Contd)

SUMMARY

BMR proposes to carry out by contract on aeromagnetic survey of the Western Australian part of the Palaeozoic/Proterozoic sediment filled Officer Basin, and the peripheral areas of the Eucla Basin, Bangemall Basin, and the Musgrave and Yilgarn Blocks. The survey will cover sixteen 1:250 000 sheets, namely, BROWNE, BENTLEY, SCOTT, ROBERT, YOWALGA, TALBOT, COOPER, THROSSELL, WESTWOOD, LENNIS, WAIGEN, NEALE, VERNON, WANNA, JUBILEE and MASON. This report summarises important aspects of the geology and geophysics of the survey area, highlight various problems which have emerged, sets out objectives for the aeromagnetic survey and disscusses the design of the survey.

The geology of the Officer Basin in Western Australia comprises gently folded Proterozoic sediments possibly up to 5000m thick, overlain by essentially flat-lying Phanerozoic sediments about 1000 m thick. Both of these are potential hydrocarbon producers. However exploratory drilling by Hunt Oil Co on suitable dome structures failed to find oil or gas in the Palaeozoic. Geophysical surveys have produced conflicting interpretations of depth to the base of the Proterozoic. For example the 1972 BMR seismic survey near Lake Throssell recorded reflections from depths in excess of 10 000 m; reconnaissance aeromagnetic lines indicated a depth to magnetic basement of less than 5000 m. It is considered that the major problem in the Officer Basin is to resolve which levels in the stratigraphic succession are magnetic basement. Consequently special attention is drawn to rock units in areas peripheral to the Officer Basin, for example those of the Musgrave block. It is possible that the Table Hill Volcanics at the base of the Palaeozoic section will be a useful magnetic marker.

In regions surrounding the survey area there is good positional correlation of prominent Bouguer anomalies with prominent magnetic anomalies. Thus within the survey area, the trend direction of Bouguer anomalies has been taken as a guide, in conjunction with the geology, to determine flight line

directions. The survey has been divided into 5 panels in which various combinations of flight line direction, line spacing and altitude apply. Line spacings will be 1500 m over hardrock areas and 3000 m over the basins. While some of the survey will be flown at constant barometric altitude and some will be flown at constant ground clearance, the effective ground clearance will be about 150 m throughout the whole area. This low altitude surveying is essential in the hardrock areas of the Musgrave and Yilgarn Block, and also is desirable in the basin areas, because it is likely that weak anomalies from near surface magnetic sources will be encountered, in addition to deeper source anomalies.

Flexibility in the density of magnetic coverage has been called for in the survey design which will result in areas of special interest being reflown if necessary. For example known diapiric structures may require more detail to assist with interpretation. Thus an extra 8000 line kilometres is to be set aside in the contract to allow for 'fill in'.

1. INTRODUCTION

The Bureau of Mineral Resources (BMR) proposes to carry out by contract an aeromagnetic survey over sixteen 1:250 000 sheet areas of the Western Australian (W.A.) part of the Officer Basin (Palaeozoic/Proterozoic sediments), the northern part of the Eucla Basin (Tertiary sediments), and adjoining parts of the Bangemall Basin, and the Musgrave and Yilgarn Blocks (Plates 1 & 2). This report summarises important aspects of the geology and geophysics of the survey area, highlights various problems which have emerged, sets out various objectives for the aeromagnetic survey, and discusses design of the survey.

The main objective of the work is to gain new information about the thickness of sediments and structure of the Officer Basin. The aeromagnetic survey forms the last phase of the current series of BMR regional investigations of the Officer Basin, which since 1970 include geological mapping (Lowry, Jackson, Van de Graff & Kennewell 1972; Jackson, 1971), seismic traverses (Harrison, 1973), and helicopter gravity surveys (Fraser, 1973). The BMR program has been in conjunction with work by the Geological Survey of Western Australia.

Much of the W.A. part of the Officer Basin was subject to A.P.'s held by the Hunt group of oil companies from 1961 to 1966. The companies mounted an extensive exploration program which included reconnaissance geological mapping, reconnaissance aeromagnetic traverses across the basin, gravity surveys, and extensive seismic surveys in the northern part of the basin. Drillholes designed to test targets located by seismic survyes in the Palaeozoic section failed to produce encouraging results and Hunt accordingly abandoned exploration for hydrocarbons in this area (Jackson, 1966).

While most of the survey area is underlain by Palaeozoic and younger sediments, the northeast is underlain by Precambrain metasediments and intrusives of the Musgrave Block, and the west is underlain by Precambrian rocks of the Yilgarn Block and Bangemall Basin. These areas are of interest for their minerals potential rather than for hydrocarbon accumulation. Accordingly, the aeromagnetic survey has been tailored to suit the requirements of each area.

2. PHYSIOGRAPHY

Most of the area of the survey is a flat, arid sand dune covered desert, and falls within the Gibson and Great Victorian Deserts. The general elevation increases from about 200 m above sealevel in the south to 500 m in the north (Plate 3). Except in the northeast of the area, where hills and various strike ridges reach 100 m or more above the plains, most local features, for example mesas and buttes, are less than 50 m high. Breakaways produce scarps of up to 25 m high; sand dunes trend east-west and are up to 25 m high and 15 km long. The drainage system is relict and trends south; shallow rarely filled salt lakes up to 50 km or more long, define part of the system. Water is scarce; the annual rainfall of most of the area is less than 20 cm and surface water is almost non-existent except after heavy rain. The temperature reaches 40° Celsius in the summer months (December to February) while in winter, drops to 4° or less, and occasional frosts occur. Vegetation is sparse, and mainly consists of spinifex and mulga scrub.

The population of the area is low; the main centres are Laverton (Laverton Shire population 744 in 1971), Warburton Mission, and Cosmo Newberry Mission.

Access to the area, other than by aircraft is difficult; the most used track is that between Laverton and Warburton Mission. Various airstrips in the survey area were established during the Hunt Oil exploration program in 1961-1966. The approximate position of these and other airstrips are shown in Plate 4. The nearest civil airports to the survey area are Kalgoorlie, which is 250 km to the south of Laverton, and Forrest, on the Trans-continental Railway, 350 km southeast of Neale Junction.

3. GEOLOGY

The geology of the survey area is discussed in five sections. These are:

1. Officer Basin
2. Eucla Basin
3. Musgrave Block
4. Yilgarn Block
5. Bangemall Basin

Because the major objective in the aeromagnetic survey is the study of the Officer Basin, the discussion of geology is mainly concerned with this area.

Officer Basin

The Western Australian part of the Officer Basin underlies about 250 000 square kilometres of the areas known as the Gibson Desert and Great Victoria Desert. The basin is a poorly defined depression filled with a little known sequence of essentially undisturbed Proterozoic and Phaner-ozoic rocks.

The limits of the basin as tentatively defined by Lowry et al (1972) are rather arbitrary. The basin lies between the Musgrave Block in the north, the Yilgarn Block and the Bangemall Basin in the west, and the Gawler Block in the east. The southern limit is taken at the northern margin of the Eucla Basin. The dividing line between the Officer and the Canning Basins is taken by Lowry et al. as the Warri Gravity Ridge (Plate 1). This ridge is a geophysical feature, which extends northwest from the Musgrave Block near Warburton Mission; it may be caused by a corresponding basement high (Lonsdale and Flavelle, 1968). The Officer Basin extends eastwards into South Australia where it covers about 100 000 km^2.

The geology of the Officer Basin has been discussed by Lowry et al. (1972), Jackson (1966), Jackson (1971), Parkin (1969), and Kreig and Jackson (1973). It was from these sources that most of the following geological information was derived.

Stratigraphy. Knowledge of the stratigraphy is fragmentary due to the widespread mantle of surficial deposits, the horizontal attitude of the Phanerozoic sediments, and the lack of deep drillholes through the section. The stratigraphy of the area will be discussed under two broad divisions; Phanerozoic, and Proterozoic.

Phanerozoic sediments. Seismic surveys in the northern part of the basin (Plate 8) indicate that the section is up to 10 000 m or more in thickness (Turpie, 1967; Harrison, 1973). This thickness consists of about 1000 m of essentially flat lying Phanerozoic rocks overlying a thick slightly folded sequence of Proterozoic rocks. Plate 5 shows the stratigraphic units currently recognised (Lowry et al., 1972). Kreig and Jackson (1973) compare the stratigraphy of the W.A. and S.A. parts of the Basin. The available evidence indicates differences between the two areas. For example, the Phanerozoic section is considerably thicker in South Australia. Munyarai No. 1 intersected 2900 m of sandstone and shales of Devonian and possibly younger age without reaching the base of the sequence (Harris, 1968): in Western Australia, between Warburton Mission and Cosmo-Newberry Mission the total thickness of the Phanerozoic is probably less than 1500 m.

Of particular interest in the Phanerozoic section is the magnetic Table Hill Volcanics (basalt) and its equivalents (see Plate 5) dated as Lower Cambrian in age (M.J. Jackson, pers com). In oucrop, and often in seismic sections, the volcanics are separated from the underlying rocks by an angular unconformity which probably defines the base of the Palaeozoic section (Kreig and Jackson 1973). While the full extent of the volcanics is not known, it appears to be a ubiquitous marker in Western Australia; it has been recognised in drillholes within the basin for example Yowalga No. 2, Lennis No. 1, and BMR stratigraphic holes; it has been recognised in outcrop around the margins of Phanerozoic sedimentation (Plate 1); it is usually detected by seismic reflection and refraction profiling. However, as yet in South Australia only one small outcrop is known, and this is on the Birksgate sheet just inside the border. On some of the seismic reflection sections the volcanics appear to be conformable with deeper layering; at this time it should not be discounted that in some areas there are Palaeozoic sediments below the basalt.

The basalt in the W.A. part of the Basin is unconformably overlain by Palaeozoic sandstones and siltstones of the Lennis Sandstone and Wanna Beds which are about 500 m thick; Kreig and Jackson (1973) suggest that the sandstone would be a suitable reservoir rock for hydrocarbons. The Palaeozoic sediments are overlain by flat-lying cover of fluvioglacial and lacustrine deposits of Mesozoic/Cainozoic age.

Proterozoic sediments. Based on a Lower Cambrian age for the Table Hill Volcanics, and the angular unconformity of sediments below, it appears likely that most of the sedimentary pile in the W.A. part of the Officer Basin consists of Proterozoic rocks. There have as yet been no drillholes deep enough to pass through the complete section; for example Hunt Oil's Yowalga

No. 2, the deepest hole so far in this part of the Officer Basin, reached 3246 feet below surface and only 456 feet of this was below the Table Hill Volcanics. Correlations between deep seismic markers and outcrop are not well established, thus knowledge of the stratigraphy of the Proterozoic rocks of the Officer Basin is incomplete. From the available evidence it seems likely that they are similar to those found in two areas, (a) against the southern side of the Musgrave Block, and (b) in the Bangemall Basin.

Along the southern side of the Musgrave Block, a poorly exposed strike belt of south dipping sediments, collectively totalling about 5000 m in thickness, extends from near Warburton Mission eastwards into South Australia. The sediments consist of shales, siltstones, fluvioglacial rocks and arkosic sandstones, all tentatively dated as Adelaidean (Plate 5); the lowest of the sediments, the Townsend Quartzite, is tentatively used by Lowry et al. (1972) as the basal unit of the Officer Basin sequence along the southern margin of the Musgrave Block. The Townsend Quartzite has also been mapped on the western side of the Officer Basin.

In the Bangemall Basin, gently folded sediments with interlayered basic sills and dykes have been mapped by Mack & Herrmann (1965). These sediments dip northwards from the Yilgarn Block; dips rarely exceed 5 degrees. Their thickness, stratigraphic and structural relationship to the Proterozoic sediments south of the Musgrave Block; dips rarely exceed 5 degrees. Their thickness, stratigraphic and structural relationship to the Proterozoic sediments south of the Musgrave Block are largely unknown. Lowry et al. (op. cit.), tentatively equate them with rocks of the Musgrave Block which are older than the Townsend Quartzite. Of particular interest to the magnetic survey are the igneous dykes and sills within the sediments of the Bangemall Basin. These are magnetic (Appendix 1) and may therefore be useful in depth to magnetic basement studies in the west of the Officer Basin.

Structure. While recent BMR seismic surveys in the north of the Officer Basin, and geological mapping have given grounds for a substantial revision of the early interpretation by Hunt Oil (Jackson, 1966) of the structure of the basin (cf Tectonic Map of Australia and New Guinea, 1971) the picture is far from complete. Jackson (op. cit.), largely guided by a poorly controlled depth to magnetic basement map, considered that the basin was a narrow asymmetrical graben aligned NW/SE attaing its greatest depth of approximately 5000 m adjacent to the northeast margin. The recent seismic surveys between Warburton Mission and Cosmo Newberry Mission indicate that the deep part of the basin is much wider than previously thought. It is nearly symmetrical in shape, and is at least 10 000 m deep. It is considered that Jackson's interpretation of the magnetic data in terms of depth to magnetic basement is over simplified. Probably there are several horizons in the succession in the area which cause magnetic anomalies. This is discussed further in Chapter 4, and a speculative structural interpretation based on recent information is shown on Plate 7.

Most is known of the structure immediately south of the Musgrave Block. In Western Australia, steeply south dipping Upper Proterozoic sediments, taken as the oldest of the Officer Basin sequence by Lowry et al. (1972), unconformably overlie rocks of the Musgrave Block. In South Australia, gravity and seismic data indicate that the rocks of the Musgrave Block overthrust the sediments of the Officer Basin by up to 50 km (Milton and Parker, 1973).

In the central part of the Officer Basin between Warburton and Cosmo Newberry Missions, seismic surveys indicate broad folds in the Proterozoic rocks. The overlying Phanerozoic rocks mainly are flat lying and essentially unfolded. However, to the west and northwest of Warburton Mission, Phanerozoic beds are domed and pierced by diapiric cores of evaporitic Proterozoic rocks (Wells, 1973). Examples are the Madley Diapirs (Wilson, 1967) at Woolnough Hills on the *MADLEY sheet, and Browne Diapir on the BROWNE Sheet.

Apart from these two areas there is as yet little evidence of widespread distribution of unexposed diapirs in the basin. No igneous intrusives have been recognised in the diapirs (Wells, Jackson, pers com).

The structure of the basin in the far west is uncertain, except along BMR's Warburton-Cosmo Newberry Mission traverse. Here near Lake Throssell (Plate 1), the recent seismic survey (Harrison, 1973) reported at least 8000 m of gently dipping sedimentary section in an area where it was previously believed (Jackson, 1966) that the total section was less than 1000 m thick. The seismic sections indicate shallowing of the sedimentary section westwards onto the Yilgarn Block. Most of the 8000 m may consist of Proterozoic sediments similar to those of the Bangemall Basin.

The southern margin of the Officer Basin is tentatively defined by Lowry et al. (1972) as the northern margin of the Tertiary sediments of the Eucla Basin. This is an arbitrary boundary and Palaeozoic and/or Proterozoic sediments of the Officer Basin may underlie part of the Eucla Basin.

In the Officer Basin, recognised faults in the Phanerozoic section are rare. Although these have small displacement (15 m) vertically, they extend for 50 km or more in length; therefore it is likely that they delineate major structures at depth. The seismic evidence suggests that faults are more common in the underlying Proterozoic section. No igneous intrusives have been recognised in or near the faults (Kennewell, pers com).

Hydrocarbon potential. Suitable hydrocarbon traps have been mapped by the seismic method in Western Australia, but as the greatest part of the sedimentary section of the Officer Basin is of Proterozoic age, a high hydrocarbon potential is unlikely. The few Hunt Oil drillholes completed to test suitable structures in the Phanerozoic section encountered only minor traces of oil and gas (Jackson, 1966). However, large areas of unexplored Phanerozoic rocks occur in the basin, expecially near the South Australian-Western Australian border and despite the discouraging signs, it is still too early to fully assess the potential of the basin (Kreig & Jackson, 1973).

Little is known about the Proterozoic section, either from outcrop or drill core. Work proceding on various Precambrian sediments throughout the world shows the presence of considerable quantities of organic carbon in such sediments. Vassoyevich, Vysotskiy, Sokolov & Tatarenko (1971), and Murray (1965 a & b) consider that Late Proterozoic sedimentary deposits should not be indiscriminately written off as unprospective hydrocarbon producers.

Eucla Basin

The Eucla Basin (Plate 1) is a shallow coastal basin filled mainly with undeformed Mesozoic and younger sediments. It covers some 150 000 km^2, of which about three quarters lies in Western Australia. The basin extends southwards from the Officer Basin to the Great Australian Bight, eastwards to the Gawler Platform in South Australia, and westwards to the Yilgarn Block. The geology of the W.A. part is discussed by Lowry (1970a); that of the S.A. part is summarised by Parkin (1969).

The geology of the two 1:250 000 sheets of the Eucla Basin within the survey area, JUBILEE and MASON, is discussed by Lowry (1970 b) and Van de graff (in prep.). These sheet areas are covered mostly by a thin veneer of flat lying Tertiary sediments, i.e. the Plumridge Beds and the Colville Sandstone. Although these probably total no more than 100 m in thickness, they effectively blanket the area. The subsurface geology is largely unknown. However, from reconnaissance aeromagnetic surveys (Jackson, 1966; Quilty & Goodeve, 1958) and drilling operations (e.g. Eyre No. 1, Gambanga No. 1)

* Throughout this record 1:250 000 sheets will be referred to in capitals

to the south of the survey area, it is evident that the Phanerozoic sedimentary section is flat lying and is mainly less than 1000 m thick. To the east, in South Australia, aeromagnetic surveys (Steenland, 1965 a & b; Waller, Quilty & Lambourn, 1972) indicate that the Phanerozoic sediments of the Eucla Basin may be somewhat thicker (e.g. 2000 m).

The basement below the Phanerozoic section is likely to consist of a wedge of Proterozoic sediments thickening to the north into the Officer Basin. This wedge may overlie, or perhaps locally extend away from granite in the south. Proterozoic sediments, possibly equivalent to those of the Bangemall Basin crop out in the north of JUBILEE and MASON.

Musgrave Block

The Musgrave Block is an area of Precambrian metasediment and igneous intrusives covering some 80 000 km^2 at the junction of Western Australia, the Northern Territory and South Australia (Plate 1 & 9). It lies between the Amadeus Basin in the north and the Officer Basin in the south. The geology is extremely complex and mapping has been hampered by sand cover. The geology of the S.A. part of the block is summarised by Parkin (1969, p 39-45) and that of the individual 1:250 000 sheets covering the block in Western Australia is discussed by Daniels (1969a, 1969b, 1969c, 1970). Plate 9 shows a preliminary structural interpretation of the four sheets (Daniels, op. cit.). Note that each of the four sheets on this plate has its own geological reference. The geology of the northern margin of the Musgrave Block and its relationship to the Amadeus Basin is discussed by Forman (1966).

Stratigraphy. The stratigraphy of the four individual sheets of the Musgrave Block within the survey area has been discussed in detail by Daniels (op. cit.). The stratigraphic succession consists of crystalline basement overlain in the south and the north by Carpentarian and Adelaidean sediments. Some of the Adelaidean sediments on the north side of the Block have apparently been granitized (Forman 1966).

Crystalline basement the Musgrave-Mann metamorphics. Much of the core of the area is underlain by the Musgrave-Mann metamorphics which largely consists of quartzites, gneisses, and acid to basic granulites. These are extensively intruded by granites and by the ultrabasic and basic plutonic rocks which form the Giles Complex.

Giles Complex and basic dyke swarms. The Giles Complex (Sprigg and Wilson, 1959; Nesbitt and Talbot, 1966; Parkin, 1969; Collerson et al., 1972), is the name given to the many basic plutonic masses and associated ultrabasic and acid differentiates which crop out intermittently in the Musgrave Block. These are important for their associated economic mineralization. The complex consists largely of gabbros, norites, dunites, pyroxenites, peridotites and other olivine rich rocks. The distribution of the Giles Complex is believed to be associated with a deep fracture system of crustal shears and faults. In South Australia it was found that the Giles Complex rocks are not markedly magnetic, although locally there are strong anomalies over norites on the margins of some intrusive centres (Shelley & Downie, 1971).

In the present survey area, Daniels (op. cit.) noted that within various units, titaniferous magnetite bands were present which ranged from a few centimetres to a few metres across (e.g. Jameson Range Gabbro on SCOTT). It can be expected that the magnetic response of the Giles Complex will be similar in Western Australia to that in South Australia.

Swarms of dolerite dykes are known in the area. In the east they trend mainly north to northeast, while in the west they trend mainly north-west to northeast.

Proterozoic sedimentary rocks. In TALBOT, the accepted lowest unit of the Officer Basin succession, the Townsend Quartzite, unconformably overlies south dipping metasediments of the Musgrave Block. These metasediments include the Mission Group (basic volcanics) approximately 4000 m thick, the Cassidy Group (acid and basic volcanics) approximately 3000 m thick, and the Pussy Cat Group (bands of lavas, tuffs, siltstones, quartzites) which is probably some 4000 m thick. All of these make up the Bently Supergroup which is thought to be of Middle Proterozoic age (Daniels, 1969b). Because of the presence of layered volcanics, it can be expected that the Bently Supergroup will have associated linear magnetic anomalies parallel to the strike of outcrop.

Phanerozoic sediments. Much of the Musgrave Block is overlain by thin surficial deposits, which include eolian sands, laterite and ironstone gravels probably of Tertiary age. In the area of the Cobb Depression, an elongate gravity low anomaly in SCOTT named by Lonsdale & Flavelle (1968), at least 150 m of Permian sediments are known (Daniels, 1970); these consist of siltstones, sandstones and conglomerates. Over most of the gravity feature, the thickness of the Permian succession is unknown, but it probably does not exceed 500 m.

Structure. The structure of the Musgrave Block in the survey area is discussed by Daniels (1969a, 1969b, 1969c, 1970) and a sketch map compiled from these references is shown in Plate 9. The structure will not be discussed in detail here. However, it is important to point out that several periods of deformation and igneous activity have occurred and numerous faults transect the area. From the sketch map it appears that some of the faults are minor and extend for only a few kilometres, while others are major features across which substantial movement has occurred. The northeast fault across COOPER and SCOTT is an example of such a major feature.

The geological trends of mapped formations tend to lie between northwest (e.g. Giles Complex) and east-west (e.g. Bently Supergroup). Fault trends lie between northwest and northeast.

Economic Geology. Daniels (op. cit.) discussed the known mineralization in the survey area. Copper sulphides occur both in veins and as bedded deposits in sediments near Warburton Mission (Mission Group). Copper minerals also occur in the gabbroic rocks near Mt Gosse, and within titaniferous magnetite bands near Jameson Range (SCOTT). Some of the ultrabasic rocks are deeply weathered and ochres have formed which in some cases carry concentrations of nickel as silicate or oxide minerals. Such an ochre is associated with the Giles Complex near Wingellina (COOPER) where South Western Mining Co Ltd have proved 60 million tonnes of 1.32 percent nickel. Vanadium (approx. 0.75% V_2O_5), has been detected in the titaniferous magnetite bands associated with gabbros, e.g. Jameson Range Gabbro. Daniels has suggested the possibility of finding platinum associated with Giles Complex rocks, and uranium with Proterozoic conglomerates of the Tollu Group.

Bangemall Basin

The geology of this basin of Proterozoic sediments is largely unknown. A brief discussion is included in the discussion of Proterozoic sediments of the Officer Basin (page 5).

Yilgarn Block

The part of the Yilgarn Block which adjoins the survey area is named the Eastern Goldfields Province. The geology of this area of Archaean rocks was discussed by Williams (1973). He divided the province into three N-S trending sub-provinces on structural, lithological and geochemical grounds. This subdivision will not be discussed in detail here.

The province can be divided into two major geological components, the complex intrusive granite-migmatite areas (whitestones), and the greenstone belts. The greenstones are a metamorphosed layered succession of basaltic rocks which occupy some 30% of the province. Intrusive ultrabasic rocks within the greenstones are important because of associated nickel mineralization. Until the mid 1960's, interest in economic mineralization was confined mainly to gold, occurrences which in general are restricted to greenstone belts near the contact with granite bodies. The internal structure of the narrow (50 km wide) greenstone belts is mostly synclinal. Major fold axes roughly parallel the NNW elongation of the individual rock units, the belts being draped around concordant granite-migmatite complexes.

Developments of banded iron formations (BIF) occur both in the greenstones and the whitestones. The BIF's and basic rocks produce prominent linear aeromagnetic anomalies which in general trend NNW (Young 1971). Some anomalies are of extremely high amplitude, BIF's for example commonly produce anomalies in excess of 3000 gammas. Young, rationalised the contour maps of total magnetic intensity of the Eastern Goldfields Province in terms of geology. He equated zones of magnetic anomalies of increasing amplitude with increasing basicity of rock. Numerous cross trending dolerite dykes (E-W) have been mapped many of which are only delineated by their magnetic response.

4. GEOPHYSICS

The survey area has been covered by regional helicopter gravity surveys. Aeromagnetic reconnaissance traverses have been flown across the area both by BMR and by Hunt Oil. Seismic surveys have also been carried out by BMR and Hunt Oil. Plates 8, 10, 12 & 14 illustrate this geophysical survey coverage within and adjacent to the proposed survey area.

Seismic Surveys

Seismic reflection and refraction surveys by Hunt Oil (Campbell, 1964; Kendall & Hartley, 1964; Mickleberry, 1966a; Mickleberry, 1966b) summarised by Jackson (1966), and the BMR surveys (Turpie, 1967; Harrison, 1973), have mainly been confined to the northern part of the Officer Basin. The most important points brought out by this work are:

(1) The existence of 10 000 m or more of essentially flat lying rocks in the Officer Basin,

(2) The widespread extent of a nearly flat lying reflection and refraction marker horizon at a depth of about 1000 m, correlated with the Table Hill Volcanics,

(3) The lack of agreement between seismic depth to basement estimates and depth to magnetic basement estimates,

(4) The existence of structures suitable for the trapping of hydrocarbons.

Problems of particular concern to the aeromagnetic survey, which are evident from the seismic work are:

(1) In the light of (3) above, the need for revision of the Officer Basin boundaries,

(2) The identity of the major part of the sedimentary section is unknown,

(3) The subsurface extent and depth of the Table Hill Volcanics is yet unknown in much of the basin particularly the east and south; hence the thickness of the Phanerozoic part of the sedimentary section is largely unknown.

Gravity Surveys

To date the main use of the helicopter gravity data has been limited to qualitative discussion (Fraser, 1973; Rowan, 1967; Bazhaw & Jackson, 1965b). As yet no regional rock sampling program has been undertaken for density measurements to enable the gravity anomalies of the Officer Basin to be interpreted quantitatively. The results of a preliminary study of densities are shown in Appendix 1.

The Officer Basin, both in Western Australia and South Australia is a region of negative Bouguer anomaly, flanked in the north by a belt of positive anomaly (Musgrave Block) and in the west and east by regions of complex patterns associated with shield areas (Yilgarn Block, Gawler Block), and finally in the south by a complex arc shaped high-low anomaly pattern associated with the Eucla Basin. The generally broad and open Bouguer anomaly pattern over the Officer Basin in Western Australia is transected by various local and regional anomalies, which are probably caused by sources within the Basement below the basin sedimentary fill rather than by relief in the basement surface.

One of these transecting features, a Bouguer anomaly high Plate 10 extends from southwest of CUNDEELEE through VERNON to TALBOT where it intersects the gravity high associated with the Musgrave Block. Rowan (1967) considered that the gravity high over the Musgrave Block is caused partly by dense rocks of the Giles Complex and partly by unexplained deep crustal features. Fraser (1973) has interpreted the anomaly pattern of the area in terms of plate tectonics. He considers that the transecting gravity high across the Officer Basin might delineate an ancient plate boundary. Of particular interest to the aeromagnetic survey is the fact that this and other prominent gravity features have strong associated magnetic anomalies. For example examine, NEALE, VERNON, PLUMRIDGE and CUNDEELEE on

Plates 10, 12 & 14. Thus the gravity pattern, as expected, is a useful guide for the determination of flight line directions appropriate to delineate basement magnetic anomalies in the Officer Basin. With this purpose in mind trend directions of prominent Bouguer anomalies were drawn (Plate 11).

Magnetic Surveys

Contour maps of total magnetic intensity from aeromagnetic surveys surrounding the survey area are shown on Plates 12 and 14. Linear trends due to shallow sources (0-1000 m depth) are shown on Plate 13. Some of these were taken from BMR records (e.g. for MANN, BIRKSGATE - Shelley & Downie, 1971), while others were selected from contour maps of BMR and company work.

In addition to the peripheral work shown on the plates, reconnaissance lines have been flown across the Officer Basin both by BMR and by Hunt Oil. Hunt Oil flew six northeast lines spaced at approximately equal intervals across the W.A. part of the basin. An interpretation of these (Jackson, 1966), indicated that the magnetic basement of the Officer Basin, which is presumed to lie at the base of the Upper Proterozoic, defined an assymetric basin with the deepest portion south of the Musgrave Block (see Plate 7). The maximum depth to magnetic basement was estimated at about 5000 m.

Subsequent seismic reflection and refraction surveys (Harrison, 1973) have indicated sediment thicknesses in excess of 10 000 m. Moreover, thicknesses of this order have been found in the south west of the basin near Lake Throssell, where depth to magnetic basement is less than 1000 m as interpreted by Jackson. It seems likely that there are several levels in the succession which give rise to magnetic anomalies. This could account for the gross discrepancies between depth estimates from magnetic and seismic surveys.

In South Australia adjacent to the survey area, the Exoil aeromagnetic survey of the Officer Basin (Steenland, 1965) indicated the presence of more than 5000 m of nonmagnetic rocks in a linear trough aligned essentially parallel to the Musgrave Block. The survey showed the presence of three characteristic magnetic patterns. These are progressing south from the Musgrave Block:

(a) A complex of sharp linear anomalies, with amplitudes of the order of 700 gammas, attributed to rocks of the Musgrave Block.

(b) An area of essentially flat response, with broad anomalies of amplitude 200 gammas or less, attributed to deep magnetic basement at 3000 m or more.

(c) A comples of linear and circular anomalies of amplitude up to and in excess of 500 gammas, attributed to magnetic basement at medium depth.

Steenland (op. cit.) interpreted the changes in the magnetic pattern as due to both a change in depth to magnetic basement, and a change in composition of this basement. A reinterpretation of the aeromagnetic data, together with the Bouguer Anomaly data, in the light of recent seismic surveys by the South Australian Department of Mines, (SADM), across the northern margin of the Officer Basin, has indicated that rocks of the Musgrave Block are thrust over sediments of the basin by approximately 50 km (Milton & Parker, 1973). This result is similar to those for the northern margins of the Amadeus and Ngalia Basins.

A vertical field ground magnetic survey by Hunt Oil in the southern Officer Basin, near the junction of NEALE and VERNON, was conducted along and parallel to tracks, with a station spacing of about 400 m (Plate 12). The central anomaly in the contour pattern has an amplitude of 400 gammas. Interpretation by Bazhaw and Jackson (1965a), indicated a depth to magnetic basement of about 2000-4000 m. The anomaly coincides with the culmination of the gravity high which transects the Officer Basin (Plate 10), thus the gravity and magnetic sources are probably closely related.

The Gibson Desert aeromagnetic survey flown for Union Oil (Lynch, 1965), covered the extreme northern part of the Officer Basin. The total magnetic intensity map contoured at 50 gammas, shows three characteristic patterns.

(1) An intense pattern of sharp anomalies with amplitudes of 50-500 gammas in the southwest of HERBERT attributed by Lynch to unknown volcanics at shallow depth (less than 1000 m). Background anomalies, possibly attributable to a deeper magnetic basement, are very broad and conform with (2) below.

(2) Areas of broad anomalies of amplitude about 100 gammas, attributed to magnetic basement at depths of 3000-5000 m or more.

(3) A belt of northwest-trending linear and circular anomalies of amplitude about 1000 gammas, attributed to magnetic basement at medium depth. Some of the anomalies correspond in position with the Warri Gravity Ridge (Lonsdale & Flavelle, 1968); together these features indicate an extension of the Musgrave Block at relatively shallow depth viz 1000-3000 m.

The three magnetic patterns described above correspond closely in character with those described earlier for the Eastern Officer Basin.

Aeromagnetic maps for RASON, MINIGWAL, PLUMRIDGE and CUNDEELEE, and adjoining sheets to the west (Plate 14) mainly show a pattern of northeast to northwest-trending anomalies due to very shallow or exposed sources. Anomaly amplitudes in excess of 1000 gammas are common.

Linear anomalies which trend essentially eastwest transect the western part of the area. The high amplitude north to northwest-trending anomalies are associated with greenstones (basic volcanics and banded ironstones), the eastwest features are due to normal or remanently magnetized dolerite dykes (Young, 1971). Young (op. cit.) rationalised the magnetic pattern of the Yilgarn Block in terms of geology and produced an interpretative geological map. This compares favourably with, and provides more detail than, the existing geological maps of the area.

The magnetic pattern evident in CUNDEELEE, MINIGWAL and PLUMRIDGE areas shows a distinct change in character to map sheets to the west in so far as anomalies in the east trend northeast, whereas those in the west trend northwest. In the southeast corner of KURNALPI the northeast trending pattern overprints the northwest trends of the Yilgarn Block. Further to the south on WIDGIEMOOLTHA, a zone of northeast-trending anomalies lies to the east of the Fraser Fault over northeast trending granulites (cf. Wilson 1969). The zone of northeast-trending anomalies is presumably caused by steeply dipping multi layered sources within the granulite terrains. The zone corresponds in position with the intense Bouguer anomaly high which transects the Officer Basin (cf. section on gravity surveys). Whatever the source, the pattern of northeast trending magnetic anomalies is of special interest as:

1. They probably will be traceable across the Officer Basin.
2. Depth estimates will probably be true depth to sedimentary basement (Proterozoic), thus providing a valuable reference for comparison with seismic depth estimates.

The BMR survey of KINGSTON and the Union Oil Survey of HERBERT indicate the magnetic response to be expected from Bangemall Basin sediments (Proterozoic) under younger cover rocks. Geological trends of these essentially flat lying Proterozoic sediments are mainly west to northwest (Mack and Herrmann 1965), in these two areas. The KINGSTON area was flown east-west, the HERBERT area, where it is presumed that Bangemall Basin type sediments occur at shallow depth beneath Phanerozoic cover, was flown north-south. It appears that the Bangemall Basin sediments have a magnetic response in both areas, and produce discontinuous northwest trending linear anomalies mainly of amplitude 100 gammas or less.

Preliminary contours by SADM of the BMR survey of the Musgrave Block in the far west of South Australia are shown in reduced form on Plate 14. Interpretation of stacked profiles of total magnetic intensity indicates that in the extremely disturbed magnetic pattern evident over the Musgrave Block, the predominant trend of high amplitude anomalies is eastwest, corresponding to the geological trends, for example major dykes and layering in the Giles Complex rocks (Shelley & Downie, 1971). Anomalies with amplitudes in excess of 1000 gammas are common in the area and are due to exposed sources or sources at shallow depth. Zones of weaker anomalies are widespread on which more intense anomalies are commonly superimposed. Correlation of these apparently coherent units with the mapped geology was found to be difficult. Good correlation between major structural features and the magnetic pattern, was used to extrapolate geological features into poorly known areas, for example the Mann fault which has a 100-1000 gamma anomaly associated with it. It is to be expected that the magnetic pattern over the Musgrave Block in Western Australia will be similar to the complex pattern recorded over the Musgrave Block in South Australia.

Of interest to the aeromagnetic survey of the Officer Basin is the zone where the character of the magnetic pattern changes from a complex of high amplitude anomalies associated with the Musgrave Block, to an essentially flat pattern evident over the Basin to the south. In this zone, weak linear anomalous trends of amplitude 100 gammas and less, which approx-imately parallel the strike of outcrop over the south dipping Adelaidean sediments, were interpreted to indicate the presence of iron rich sediments in the Adelaidean sequence (Shelley & Downie, 1971). Analysis of this result has special relevance to interpretation of the magnetic data for the Officer Basin and serves as an example of the problems to be expected in depth to basement studies.

In the Adelaide Geosyncline an association was observed between metamorphism and the magnetic response of the Adelaidean sediments (Tipper and Finney, 1966; Tucker, 1972; McKirdy et al., 1973). Here some of the steeply dipping sediments metamorphosed to chlorite grade or higher, have strong associated linear magnetic anomalies (100-1000 gammas), attributed to metamorphic growth of magnetic minerals in beds about 300 m thick. Sediments essentially unmetamorphosed have little or no observable magnetic response on airborne records (amplitudes 5 gammas or less). On the basis of the evidence from the Adelaide Geosyncline, the anomalies recorded by Shelley & Downie (op. cit.) over the Adelaidean sediments on the north side of the Officer Basin in South Australia, may indicate that low grade regional metamorphism has occurred. If regional metamorphism has occurred then it might be expected that in some places the Adelaidean sediments will form a magnetic basement while in others they will not.

The discussion applied here to Adelaidean sediments might also apply to other sediments in the Officer Basin.

Magnetic Basement

It is likely that one of the biggest problem confronting interpretation of the aeromagnetic survey of the Officer Basin will be the problem of determining which level in the succession is the cause of the observed magnetic anomalies. There are several probable or potential sources of anomalies at various levels in the time succession. These are:

1. Rocks of the kind found on the Yilgarn Block in the Eastern Goldfields viz. greenstones, ironstones.
2. Rocks of the kind found immediately east of the Yilgarn Block viz. granulites on PLUMRIDGE and CUNDEELEE (associated with positive gravity anomaly).
3. Rocks of the kind found on the Musgrave Block, viz. basics, ultrabasics and metasediments.
4. Rocks of the kind found in the Bangemall Basin (KINGSTON), viz. sediments and interlayered igneous rocks (presumably older than Adelaidean).
5. Rocks of Adelaidean age.
6. Rocks in the Palaeozoic succession, notably the Table Hill Volcanics.
7. Laterites.

Considerable effort may be required to distinguish the various sources if they lie beneath cover...

5. OBJECTIVES OF THE SURVEY

The main aim of the aeromagnetic survey is to gain new information on the Officer Basin. As indicated in Chapter 4 it is expected that the interpretation of the magnetic data will be complicated by the presence of magnetic sources at several levels in the succession. Consequently it is important that the survey be designed to provide information of the magnetic properties of the exposed equivalents of probable buried magnetic sources in the basin. It is also important to provide suitable detailed information for furthering the understanding of the geology of the peripheral areas e.g. the Yilgarn Block, Musgrave Block, Bangemall Basin and Eucla Basin.

The objectives of the survey of the Officer Basin are as follows:

(1) To produce a depth to magnetic basement map.

(2) To identify the actual levels in the succession which cause the magnetic anomalies viz. Palaeozoic, Upper Proterozoic, or older.

(3) To provide information on the structural boundaries of the basin, viz. against the Musgrave Block, Yilgarn Block, Bangemall Basin, Canning Basin and Eucla Basin.

(4) To provide information on structures within the basin, paying particular attention to the area adjacent to the WA/SA border, where it is likely that the Palaeozoic section is considerably thicker than in the west.

The objectives of the survey of the Musgrave Block, Yilgarn Block, and Bangemall Basin are as follows:

1. To provide detailed information on the magnetic character, trends, and boundaries of near surface rock formations, as an aid to future geological mapping and mineral exploration of the areas.
2. To provide control for the interpretation of the magnetic anomalies of the Officer Basin.
3. To delineate structures within the areas.

The objectives of the survey over the northern part of the Eucla Basin are as follows:

1. To produce a depth to magnetic basement map, paying particular attention to identifying the actual levels in the succession which cause the magnetic anomalies.
2. To provide information on structures within the basin and on the structural boundary of the basin with the Officer Basin.

6. DESIGN OF THE AEROMAGNETIC SURVEY

From the foregoing discussion of geology and previous magnetic surveys it is evident that various different magnetic terrains will be covered by the new aeromagnetic survey. It is therefore necessary to tailor the flight line directions, spacing and altitude to best suit each problem. For simplicity of magnetic data processing, changes from one set of acquisition parameters to another are best made across 1:250 000 sheet boundaries. Thus some compromise is necessary between provinding adequate but economical coverage in various localities, and producing data amenable to easy processing.

Plate 2 indicates the flight line directions, flight altitude, and line spacings recommended for the aeromagnetic survey. The rationale for the survey design is discussed below.

Character of anomalies

It is likely that the amplitudes, width and character of anomalies recorded in the survey area will largely conform with those recorded by previous adjacent surveys and similar rock units. Over the Musgrave and Yilgarn Blocks it can be expected that the most prominent features recorded will be linear anomalies of amplitude up to 2000 gammas or more, with half widths of about 1000-5000 m (Areas A and B). Over both the Officer and Eucla Basins, it can be expected that linear and circular anomalies of amplitude up to 500 gammas or more, with half widths of 5000-20 000 m will be recorded, together with superimposed linear anomalies of amplitude about 5-50 gammas and with half widths of about 1000 m, due to shallow sources.

Flight-line spacing

Over crystalline basement ('hard rock') areas, where magnetic rocks are outcropping it has been conventional for BMR to fly regional surveys at a line spacing of about 1500 m. With a ground clearance of about 150 m, this spacing gives an effective swept path of about 300 m, or about 20 percent ground coverage. This is considered adequate for reconnaissance of the hard rock areas to be covered by the present survey (Areas B & D). Where the Phanerozoic section is likely to be about 1000 m or more in thickness, the flight-line spacing of 3000 m will be used (Areas C & E). With this spacing, deep source anomalies should be reasonably well defined. An area of compromise on flight-line spacing is Area A where it is possible that either shallow or deep sources might be more prominent. For economy of total line length, a 3000 m separation was chosen in Area A.

Flight-line direction

Over most areas the flight-line direction has been chosen to give approximately normal crossings to the expected magnetic trends, due to either deep and/or shallow sources.

The expected general trends of deep sources in the Officer/Eucla Basins are delineated by the gravity trends which tend to be orientated more commonly N-S than E-W. As such an E-W direction for the flight lines is appropriate (Areas C&E). The likely trend direction of shallow sources in the basins is difficult to establish. Along the west of BROWNE, YOWALGA, WESTWOOD & NEALE, it is likely that sharp anomalies due to the Table Hill Volcanics will show up with a N-S trend; here again the E-W flight direction is appropriate.

In the Musgrave Block, geological and gravity trends are mainly E-W; over the South Australian side of the Block, a N-S flight direction have been found adequate in previous surveys (Shelley & Downie, 1971). Thus N-S flight direction has been chosen for the Musgrave Block (Area D).

Over the Yilgarn Block, magnetic trends due to shallow sources are orientated mainly N-NW and to a lesser extent E-W. In Area B a N-S flight direction has been chosen to give reasonable definition of both types of features.

Over the exposed Bangemall Basin sediments, the magnetic pattern might reflect N-NW trending anomalies due to Yilgarn Block rocks beneath the sediments, or anomalies with essentially E-W trend due to the sediments. Accordingly a N-S direction has been selected for Area A.

Flight altitude

It is usual to fly hard rock areas at a continuous ground clearance of about 150 m. (cf. Area D). However over basin areas it is usual to fly at a constant barometric altitude so that interpreted depths to deep magnetic basement can be referred to simple datum; often the altitude chosen gives ground clearance of about 500 m. In such a case, the anomalies due to weakly magnetic intrasedimentary sources or minor surface sources can be difficult to detect. It is expected that very shallow magnetic sources possibly within the Phanerozoic section will be detected over the Officer Basin. Consequently it is planned that the flying of the Officer Basin will be done at a low constant barometric altitude, which will give a ground clearance of about 150 m, suitable for detecting very weakly magnetic shallow sources (viz. anomalies of 5-10 gammas). To achieve low ground clearance at constant barometric altitude, the main basin area been divided into two panels; Area C is to be flown at 600 m above mean sea level; Area E is to be flown at 500 m above sea level.

Much of the surface exposure in Area A and B is Phanerozoic and as for Areas C and E, it will be of advantage to have a common datum for depth estimates. While part of these areas are of the hard rock type, the topography is low. A constant barometric altitude of 600 m above sea level has been chosen and this will give a ground clearance of approximately 150 m over most of Areas A and B.

Fill-in flying

It is likely that in some localities important anomalies will not be adequately defined for accurate quantitative interpretation. Possibly the flight line directions chosen in some localities will not be appropriate for defining both deep and shallow source anomalies. Various geological features found during the survey to be of special interest to the overall interpretation of the magnetic data might require more detailed aerial surveying than the basic survey provides. To allow for reasonable flexibility in magnetic coverage for the survey area, 8000 line kilometres of the total line length are set aside as 'fill-in flying'. Areas requiring fill-in will be specified as the survey proceeds. Such areas might be only a few kilometres across. For example, the vicinity of the Browne Diapir (and others) should be flown in detail possibly with lines closer than 500 m apart in a total area of about 100 km^2. Other areas might require long lines at high or low levels. For example, between the Musgrave and Yilgarn Blocks there could be advantages for depth interpretation procedures, in having an estimate of vertical magnetic gradients. Several flights at various altitudes along the same line could provide useful vertical gradient data.

Ground surveys and rock property tests

As indicated in Appendix 1 preliminary studies have already been made of the geophysical properties of various available rock samples notably the Table Hill Volcanics and its equivalents. Further tests should be made on the rock cores from both subsidised and BMR stratigraphic wells in the Officer Basin. However, one of the problems in doing this is that much of the available core material is very friable and extreme care is necessary in handling it. It may be of considerable benefit to interpretation of the geophysical data if magnetically fresh rock samples can be collected during or shortly after the survey, and tested for magnetic properties and density. Ideally, any collecting of rocks should be accompanied by local ground surveys, so that it can be ascertained whether the desired magnetic formations are being tested.

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APPENDIX 1

Tables 1 and 2 show the results of tests of magnetic properties and density of various rock and core samples available from the Officer Basin. These tests were carried out in BMR, Canberra.

TABLE 1

MAGNETIC PROPERTIES AND DENSITY - OFFICER BASIN DRILLCORES

Lab. No.	Drillhole	Samplers No.	Depth (feet)	Remanence Vector Dip	Remanence Vector Magnit. x 10^{6} emu/cm3	Suscept-ibility c.g.s. x 10^{6}	Specific Gravity (Lab.dry)	Lithology	Formation	Age
72/70	Yowalga No. 2	-	2413	-62	8.7	47	2.50	Basalt (pink-brown)	Table Hill Volcanics	Lower Cambrian
72/71	"	-	2416	-52	44	118	2.62	" (brown)	(Type Section)	"
72/72	"	-	2757	-83	73	620	2.68	" (grey)	"	"
72/73	"	-	2795'8"	+35	2.1	6.8	2.55	Red-brown Siltstone	Babbagoola Beds	Prot.
72/74	"	-	2931	-73	0.4	13	2.71	Grey dolomite	"	"
72/75	"	-	3240	-38	0.6	9.3	2.46	Grey Siltstone	"	"
73/70	Westwood No. 1	1	29	-1	60	1100	2.75	Basalt (grey)	Table Hill Volcanics	Lower Cambrian
73/71	"	2	53'6"	-19	55	630	2.83	"	"	"
73/72	"	3	97	-46	45	80	2.64	"	"	"
73/73	"	4	134	-79	10	250	2.80	"	"	"
73/74	"	5	166	-41	15	380	2.87	"	"	"
73/75	"	6	197	-32	5	120	2.87	"	"	"
73/76	"	7	232	-46	6	130	2.85	"	"	"
73/77	Westwood No. 2	10	119	-80	0.3	0.1	1.7	Course porous sandstone	(?)Lennis Sandstone	(?)Cambro-Ord
73/78	"	12	327	-85	0.7	2	2.0	Cream/green sandstone	"	"
73/79	Throssell No. 1	13	608'6"	-47	2	20	2.58	Grey laminated siltstone	Babbagoola Beds	Prot.
73/80	"	13	609	-42	3	30	2.58	"	"	"
73/81	Talbot No. 3	14	246	-23	3	20	2.5	Red laminated chloritic siltstone	-	(?)Adelaidean
73/82	"	17	244	-	-	19	2.68*	Grey laminated chloritic siltstone	-	"
73/83	Talbot No. 4	15	221	-	-	21	2.63*	Red sandy siltstone	-	(?)Prot.
73/84	Talbot No. 2	16	43	-44	9	40	2.4	Buff conglomeratic sandstone	Lupton Beds	Adelaidean
73/85	"	18	42	-44	63	105	2.4	"	"	"
73/86	Talbot No. 1	19	103	+30	0.9	0.1	2.60	Buff quartzite	Townsend Quartzite	"

NOTES ON TABLE

Drillhole Location:

Yowalga No. 2	- 125°57',	26°10'
Westwood No. 1	- 124°39',	27°02'
Westwood No. 2	- 124°34',	27°06'
Throssell No. 1	- 124°23',	27°17'
Talbot No. 1	- 126°30',	26°10'
Talbot No. 2	- "	"
Talbot No. 3	- "	"
Talbot No. 4	- "	"

Core: from BMR Corestore Fyshwick.

Test samples: Cylinders 2.5 cm diameter, and approx 2.5 cm length.

Remanence Tests: Made at room temperature with spinner magnetometer. Dip measured relative to core axis, positive upwards. Accuracy ±5%.

Susceptibility Tests: Sharp Susceptibility Bridge. Accuracy ±10%.

Density Tests: Used Archimedes principle. Accuracy ±0.5%. Samples with S.G. to 2 significant figures had volume determined from dimensions, due to likelihood of disintegration if immersed in water. Accuracy ±2%. The readings indicated by (*) are a grain density, measured with a picnometer.

TABLE 2

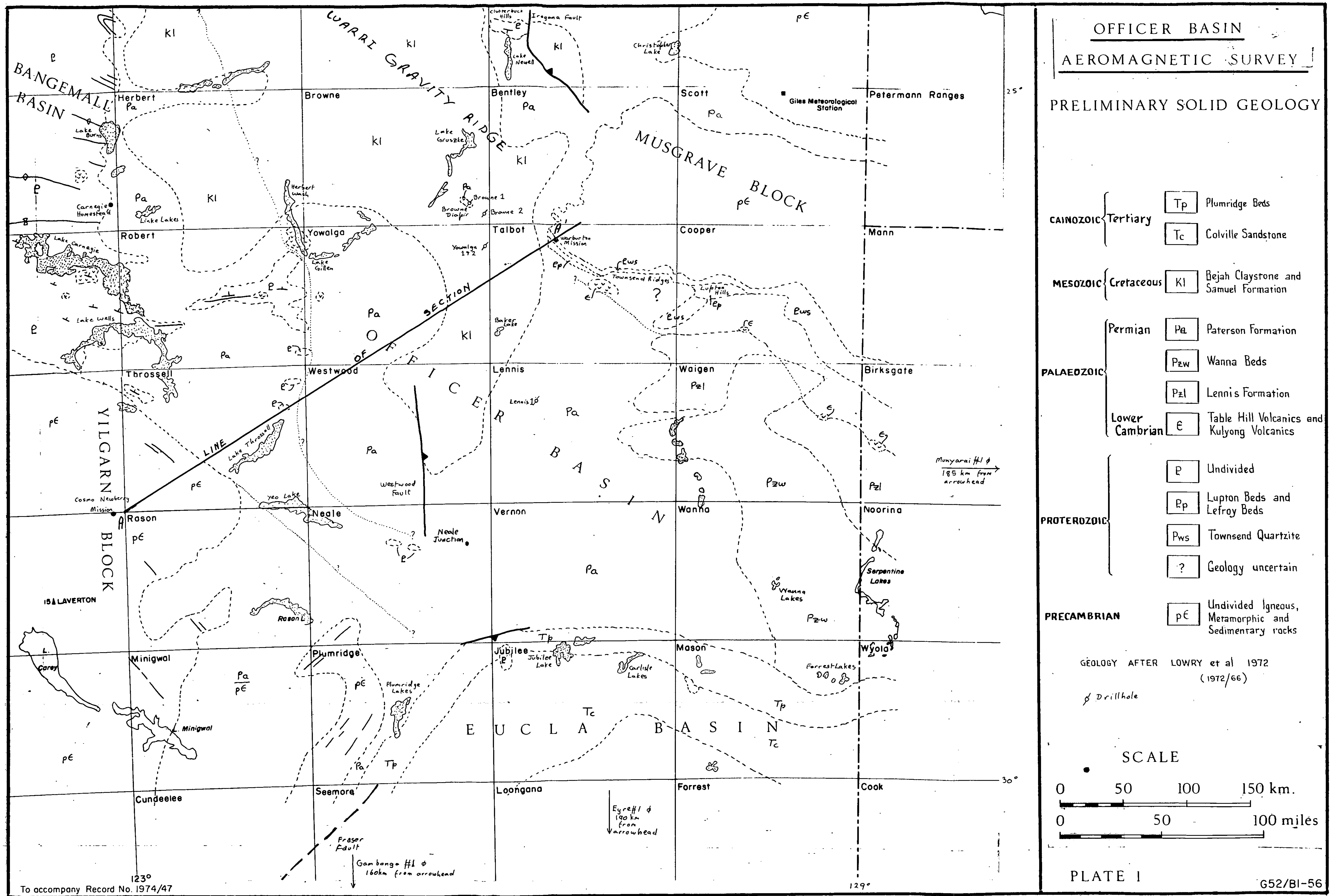
MAGNETIC PROPERTIES AND DENSITY - OFFICER BASIN SURFACE ROCKS

Lab. No.	BMR Museum No.	Locality	Susceptibility c.g.s. x 10^{6}	Specific Gravity (Lab.dry)	Lithology	Unit Name	Age
72/54	71880009	West BIRKSGATE	310	2.86	Basalt-red	Kulyong Volcanics	Lower Cambrian
72/55	71880010	(129°05', 27°40')	210	2.81	"	(South Aust equiv. of Table Hill Volcanics)	"
72/56	71880001	Central ROBERT	2600	2.98	Basalt-grey	Table Hill Volcanics	"
72/57	71880002	(123°45', 26°25'	2500	2.97	"	"	"
72/58	71880003	"	2700	2.98	"	"	"
72/59	71880004	Lake Wells KINGSTON (123°, 26°35')	2600	2.99	Dolerite-grey	Dolerite Sill	Proterozoic
72/60	71880006	"	3100	2.99	"	"	"
72/61	71880007	"	2900	2.97	"	"	"
72/62	71880011	Table Hill TALBOT (126°45', 26°20')	2200	2.83	Basalt-red	Table Hill Volcanics	Lower Cambrian
72/63	71880012	"	1400	2.86	"	"	"

Sample Source: Hand specimens from BMR Museum.

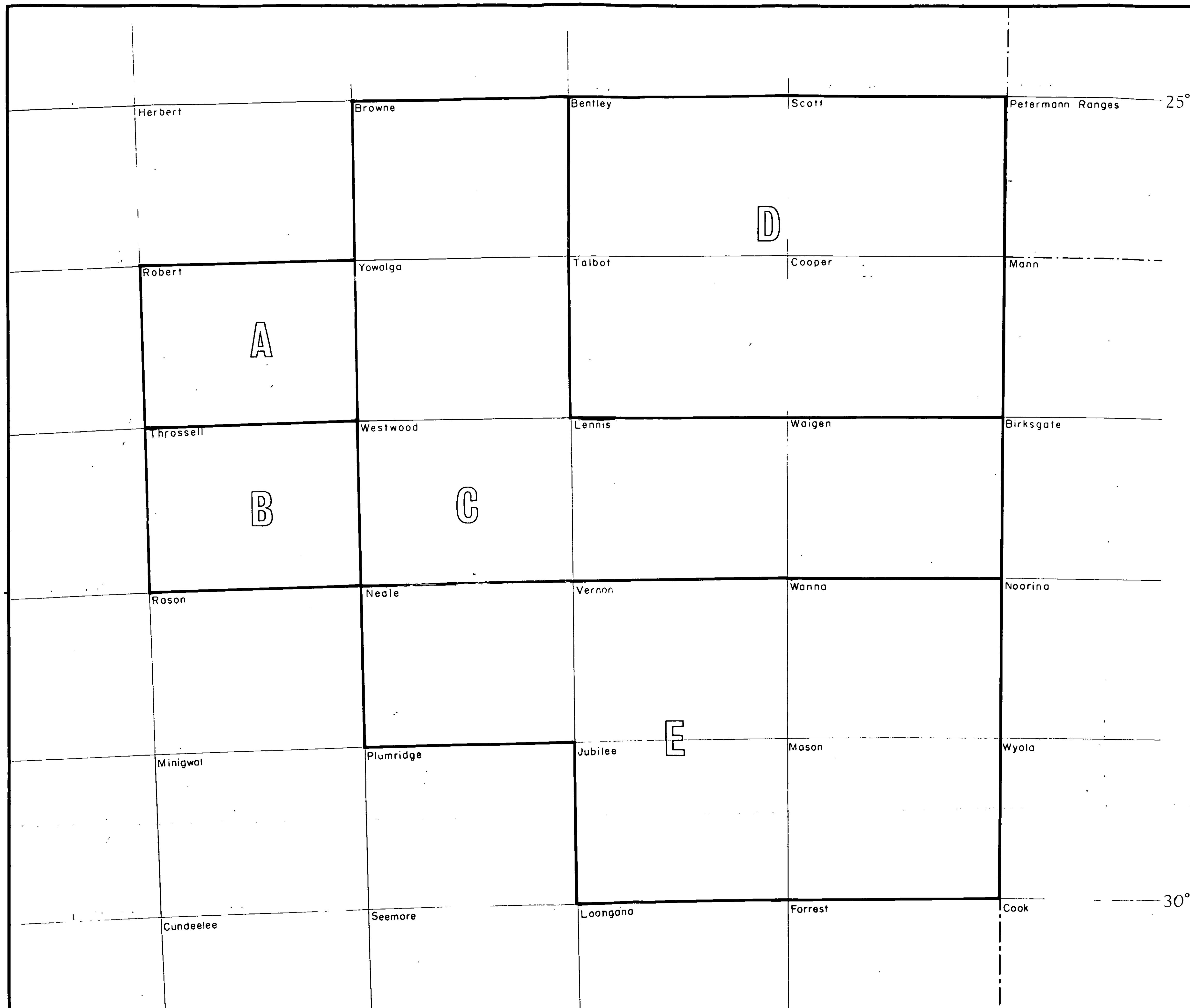
Susceptibility Tests: Sharp Susceptibility Bridge using approx 100g of rock crushed to less than 0.1 cm. Values have been corrected for pore space produced by crushing. Accuracy ±5%.

Density Tests: Archimedes Method. Accuracy ±0.5%.


OFFICER BASIN
AEROMAGNETIC SURVEY
PRELIMINARY SOLID GEOLOGY
CAINOZOIC
Tertiary
Tp
Plumridge Beds
Tc
Colville Sandstone
MESOZOIC
Cretaceous
Kl
Bejah Claystone and Samuel Formation
PALAEOZOIC
Permian
Pa
Paterson Formation
Pzw
Wanna Beds
Pzl
Lennis Formation
Lower Cambrian
Є
Table Hill Volcanics and Kulyong Volcanics
PROTEROZOIC
P
Undivided
Pp
Lupton Beds and Lefroy Beds
Pws
Townsend Quartzite
?
Geology uncertain
PRECAMBRIAN
pЄ
Undivided Igneous, Metamorphic and Sedimentary rocks
GEOLOGY AFTER LOWRY et al 1972 (1972/66)
Drillhole
SCALE
0 50 100 150 km.
0 50 100 miles
PLATE 1
G52/BI-56
BANGEMALL BASIN
WARRI GRAVITY RIDGE
MUSGRAVE BLOCK
YILGARN BLOCK
OFFICER BASIN
EUCLA BASIN
LINE OF SECTION
Herbert
Browne
Bentley
Scott
Petermann Ranges
Robert
Yowalga
Talbot
Cooper
Mann
Throssell
Westwood
Lennis
Waigen
Birksgate
Rason
Neale
Vernon
Wanna
Noorina
Minigwal
Plumridge
Jubilee
Mason
Wyola
Cundeelee
Seemore
Loongana
Forrest
Cook
Giles Meteorological Station
Iragana Fault
Christopher Lake
Lake Newell
Lake Burns
Carnegie Homestead
Linke Lakes
Lake Carnegie
Lake Wells
Herbert Wash
Lake Gillen
Lake Gruszka
Browne 1
Browne 2
Browne Diapir
Yowalga 1, 2
Warburton Mission
Townsend Ridges
Lupton Hills
Baker Lake
Lennis 1
Lake Throssell
Yeo Lake
Westwood Fault
Neale Junction
Cosmo Newberry Mission
Munyarai #1 185 km from arrowhead
Serpentine Lakes
Wanna Lakes
Rason L.
L. Carey
Minigwal
Plumridge Lakes
Jubilee Lake
Carlisle Lakes
Forrest Lakes
15 LAVERTON
Eyre #1 190 km from arrowhead
Fraser Fault
Gambanga #1 160 km from arrowhead
123°
129°
25°
30°
To accompany Record No. 1974/47

OFFICER BASIN
AEROMAGNETIC SURVEY

AREA OF THE SURVEY



To accompany Record No. 1974/47

SURVEY DETAILS

Area	Line Direction	Spacing (metres)	Altitude (metres)
A	N-S	3000	600 a.s.l.
B	N-S	1500	600 "
C	E-W	3000	600 "
D	N-S	1500	150 a.g.l.
E	E-W	3000	500 a.s.l.

SCALE

0 50 100 150 km.

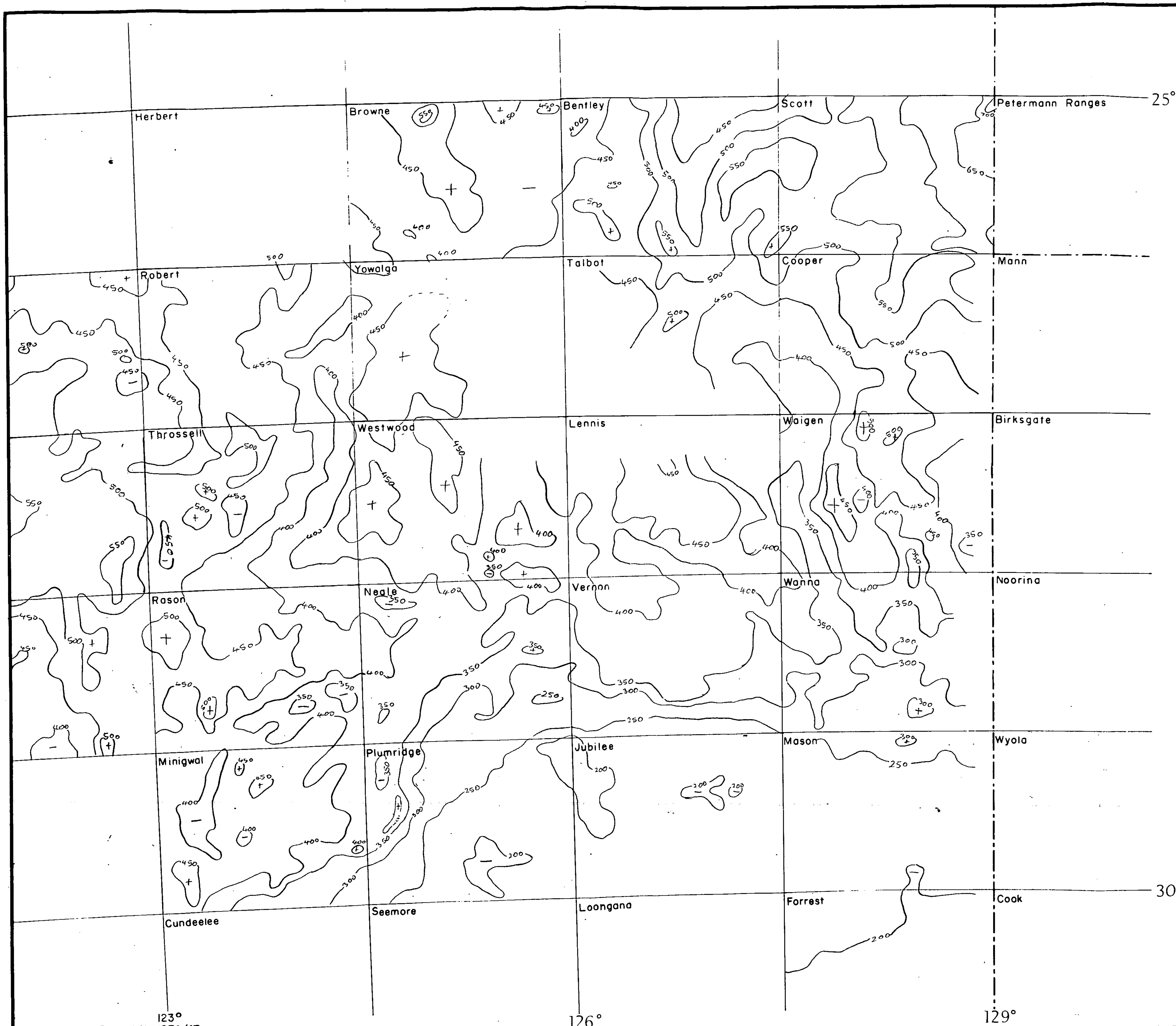
0 50 100 miles

PLATE 2

G52/BI-49

OFFICER BASIN

AEROMAGNETIC SURVEY



ELEVATION CONTOURS

Datum: A.H.D.
Contour Interval: 50 metres
Data Source: Helicopter Gravity Surveys
Grid: 11 km

SCALE

0 50 100 150 km.

0 50 100 miles

PLATE 3

G52/B1-55

To accompany Record No 1974/47

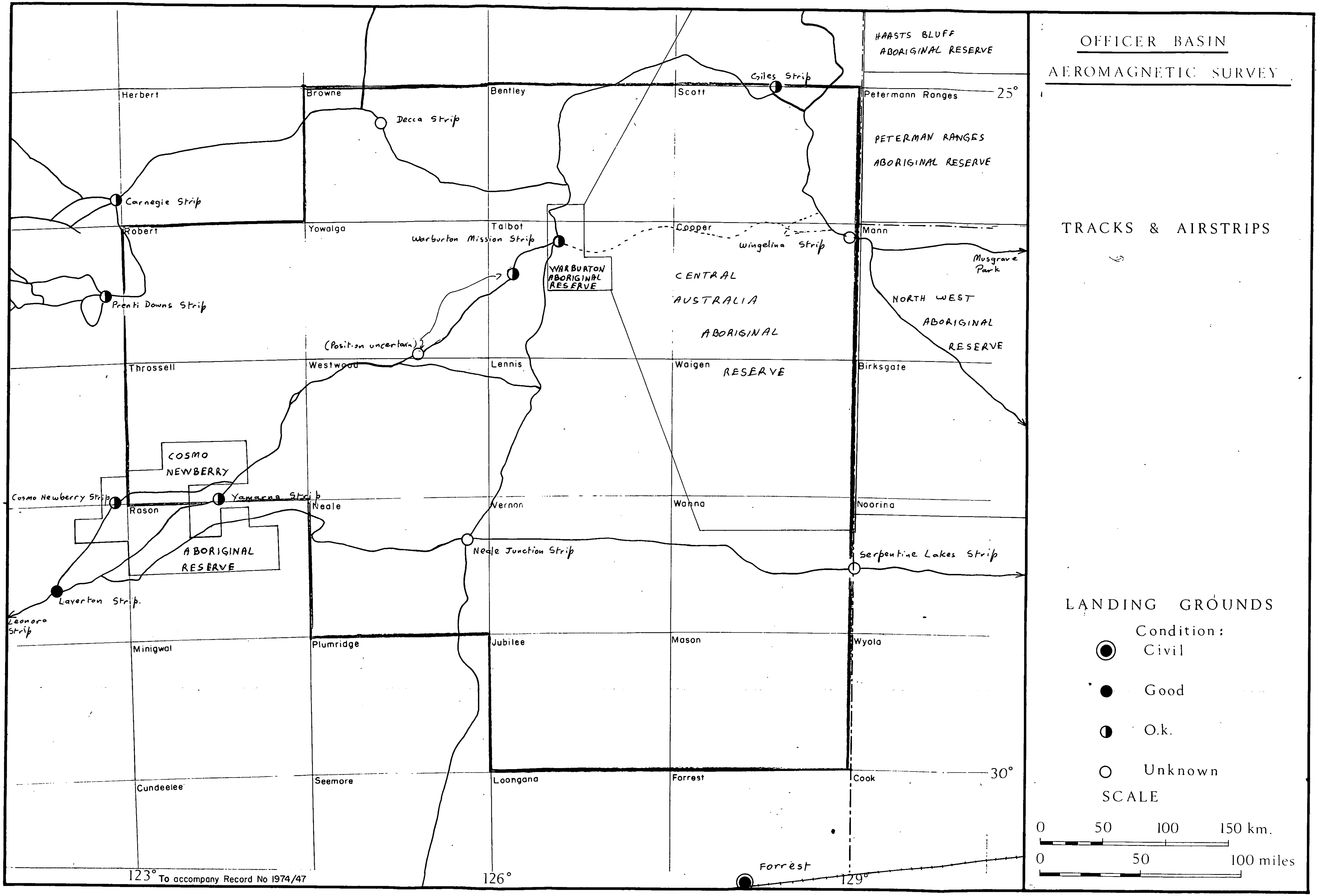
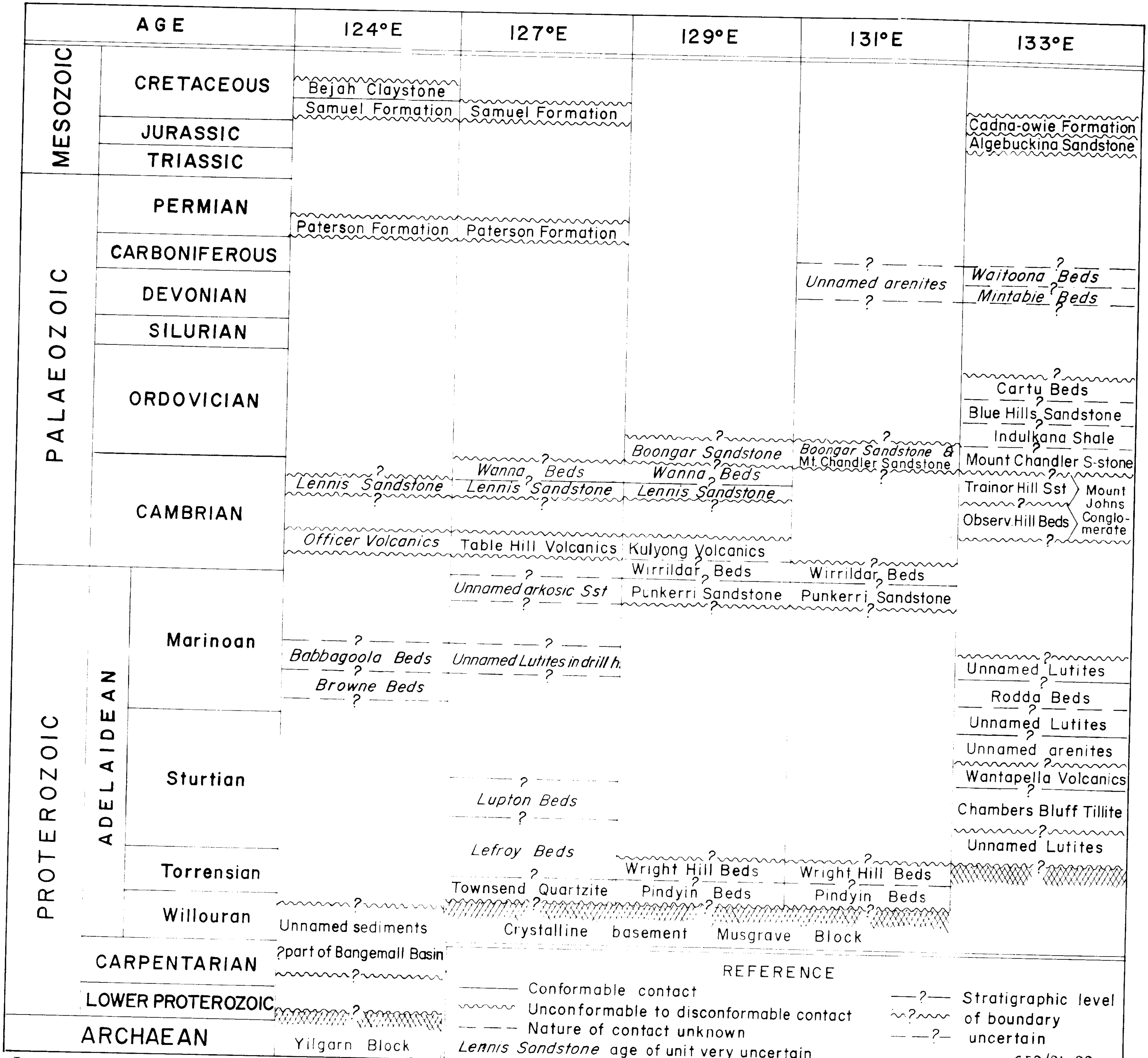


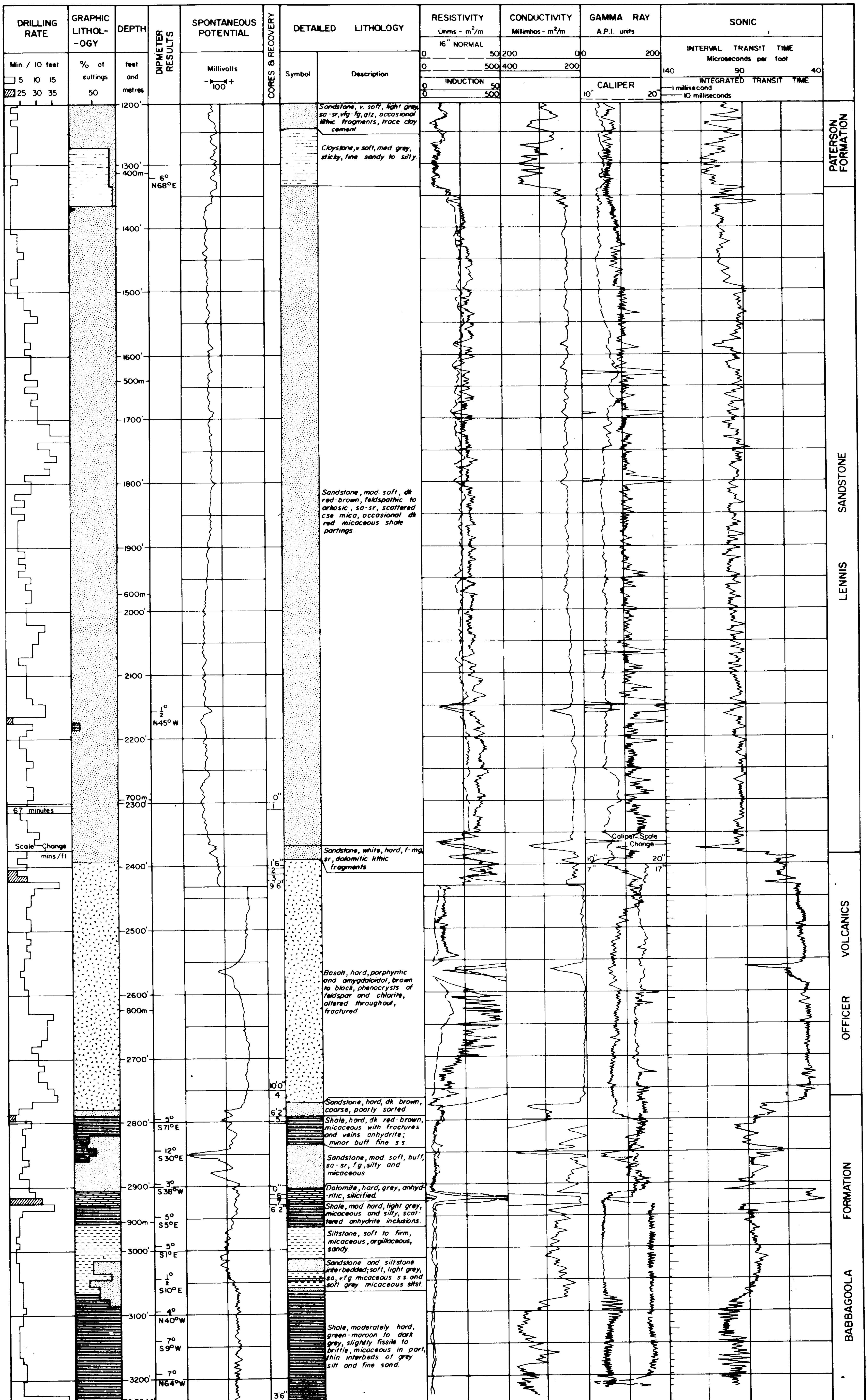
PLATE 4 G52/B1-59



To accompany Record No 1974/47

CORRELATION DIAGRAM OF STRATIGRAPHIC UNITS IN THE OFFICER BASIN

PLATE 5



To accompany Record No 1974/47

PLATE 6

TYPE SECTIONS OF THE LENNIS SANDSTONE, OFFICER VOLCANICS AND BABBAGOOLA BEDS.

(Hunt Oil – Placid Oil Well Yowalga No. 2)

G52/B1-61

SCHEMATIC INTERPRETATION OF OFFICER BASIN STRUCTURE

FROM S.W. CORNER OF THROSSELL SHEET TO WARBURTON MISSION.

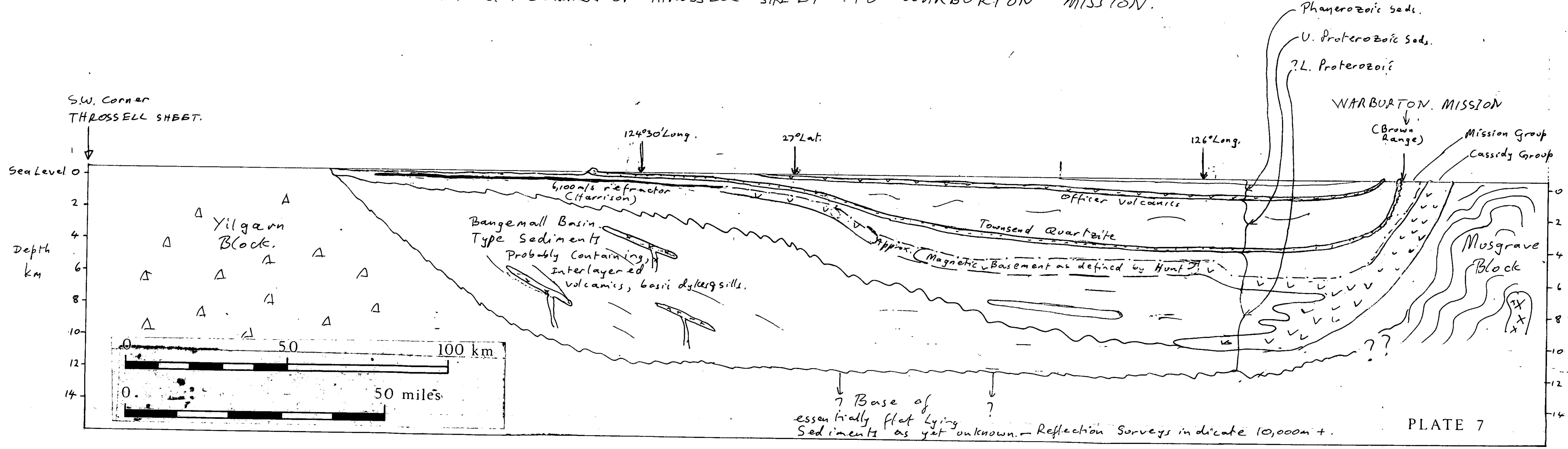


PLATE 7

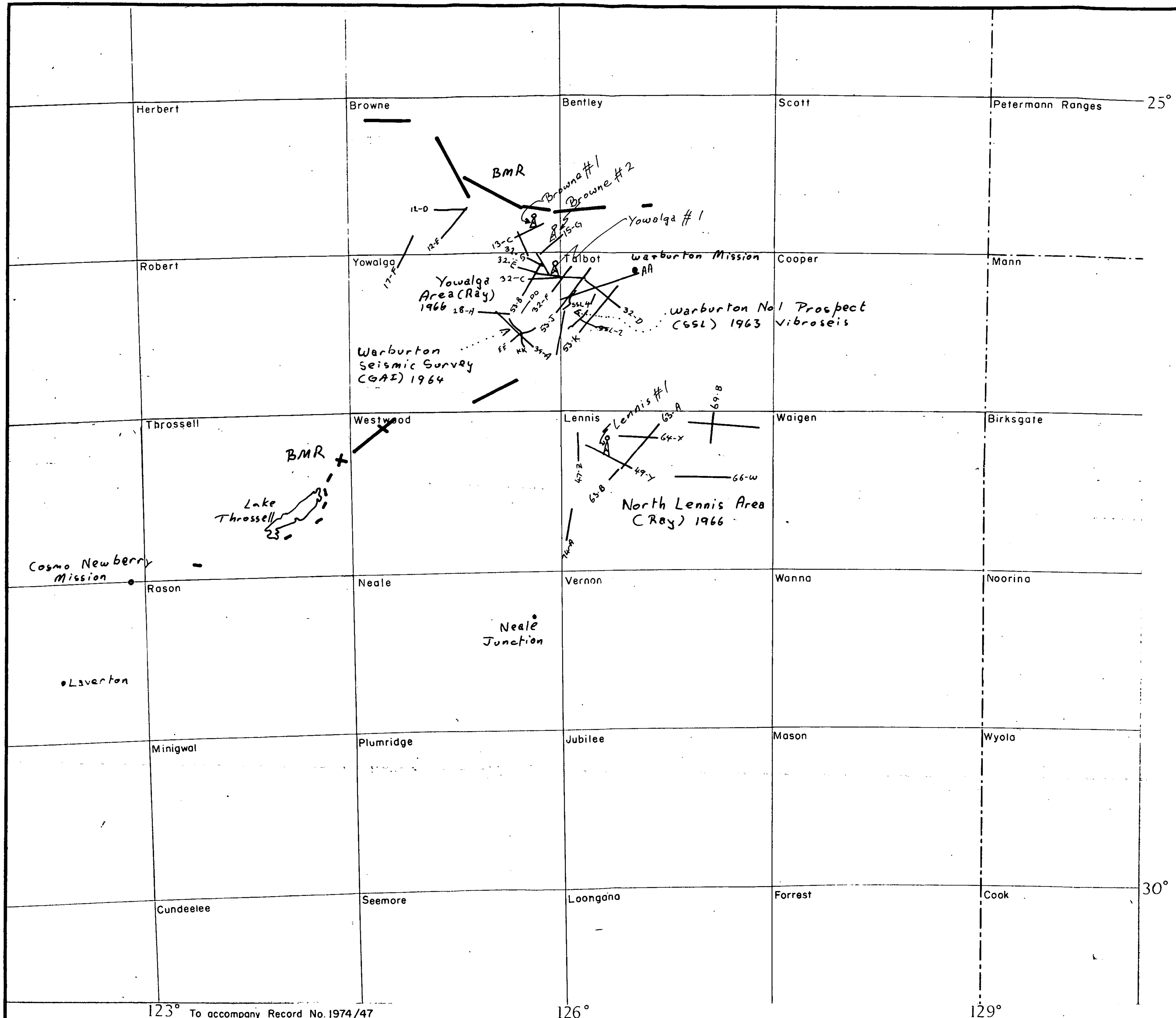
To accompany Record No. 1974/47

G52/B1-62

OFFICER BASIN

AEROMAGNETIC SURVEY

SEISMIC SURVEYS



To accompany Record No. 1974/47

SCALE

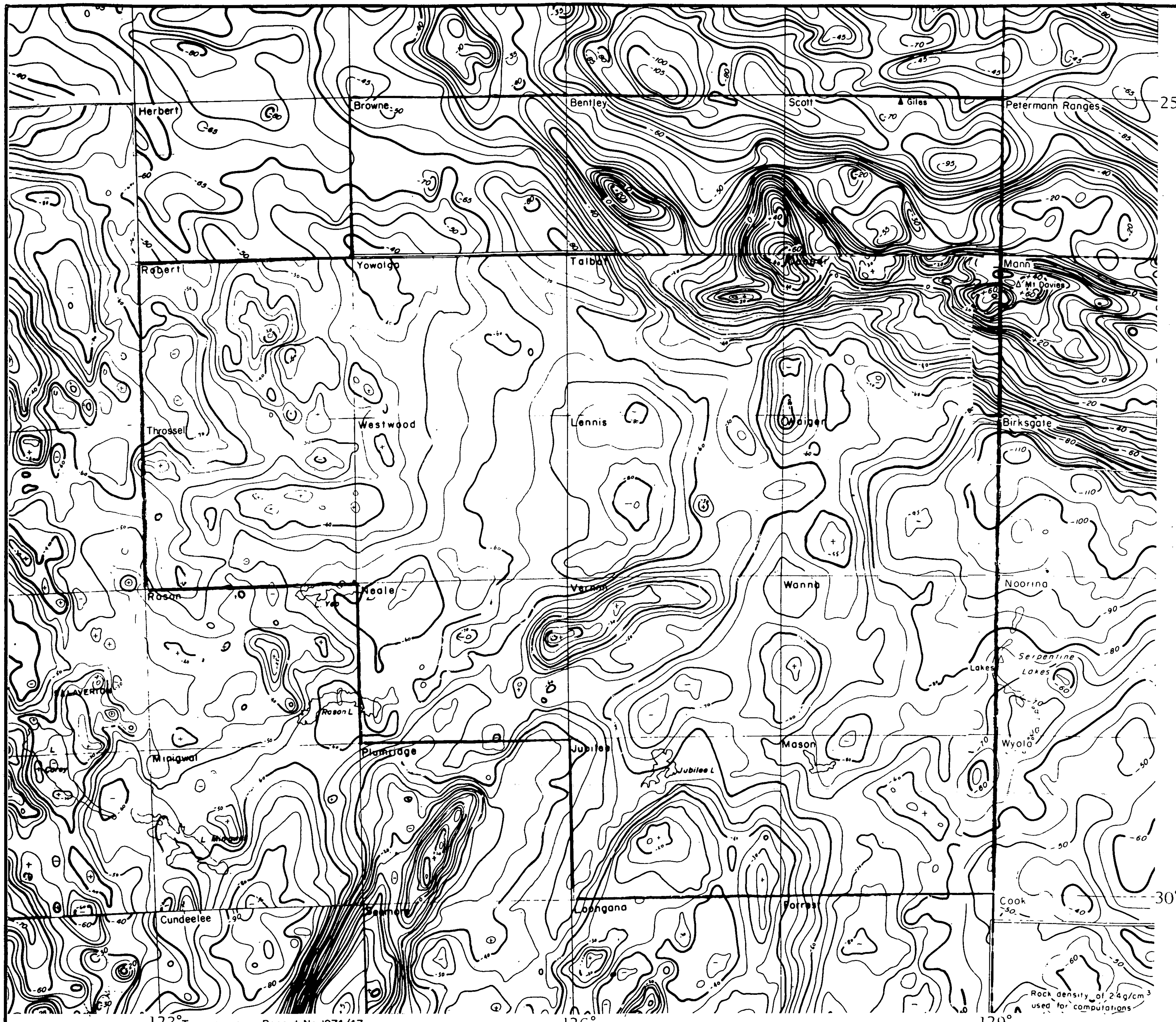
0 50 100 150 km

0 50 100 miles

PLATE 8 G52/BI-63

OFFICER BASIN

AEROMAGNETIC SURVEY



BOUGUER ANOMALY CONTOURS

Contour Interval : 5 mgal
Data Source : Helicopter Gravity Surveys
Grid : 11 km
Reduction Density : **2·2** g/cm³

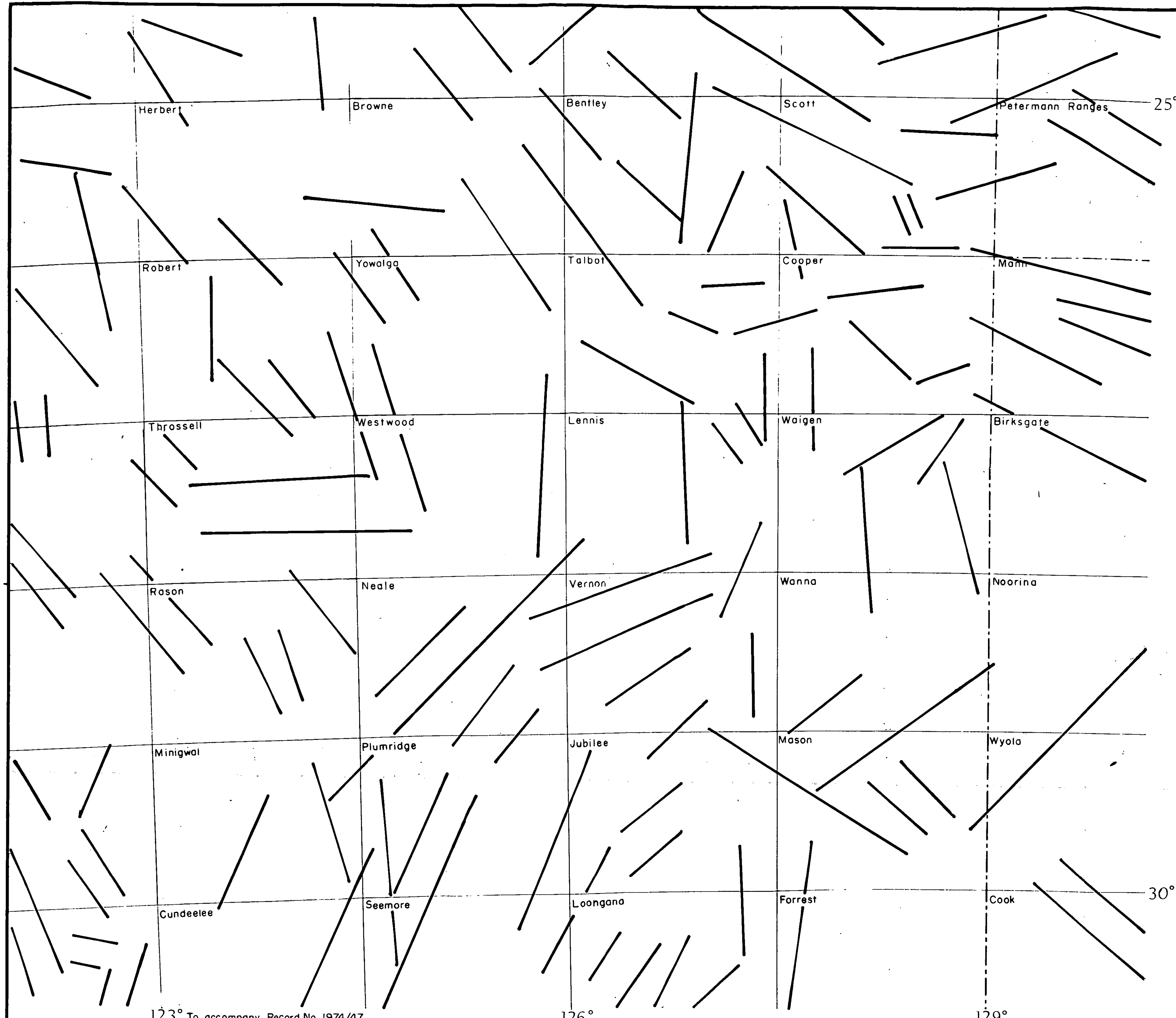
SCALE

0 50 100 150 km.

0 50 100 miles

PLATE 10

G52/B1-54



To accompany Record No. 1974/47

OFFICER BASIN

AEROMAGNETIC SURVEY

BOUGUER GRAVITY TRENDS

Data Source : Trends Delineate Inflections On Gravity Gradients

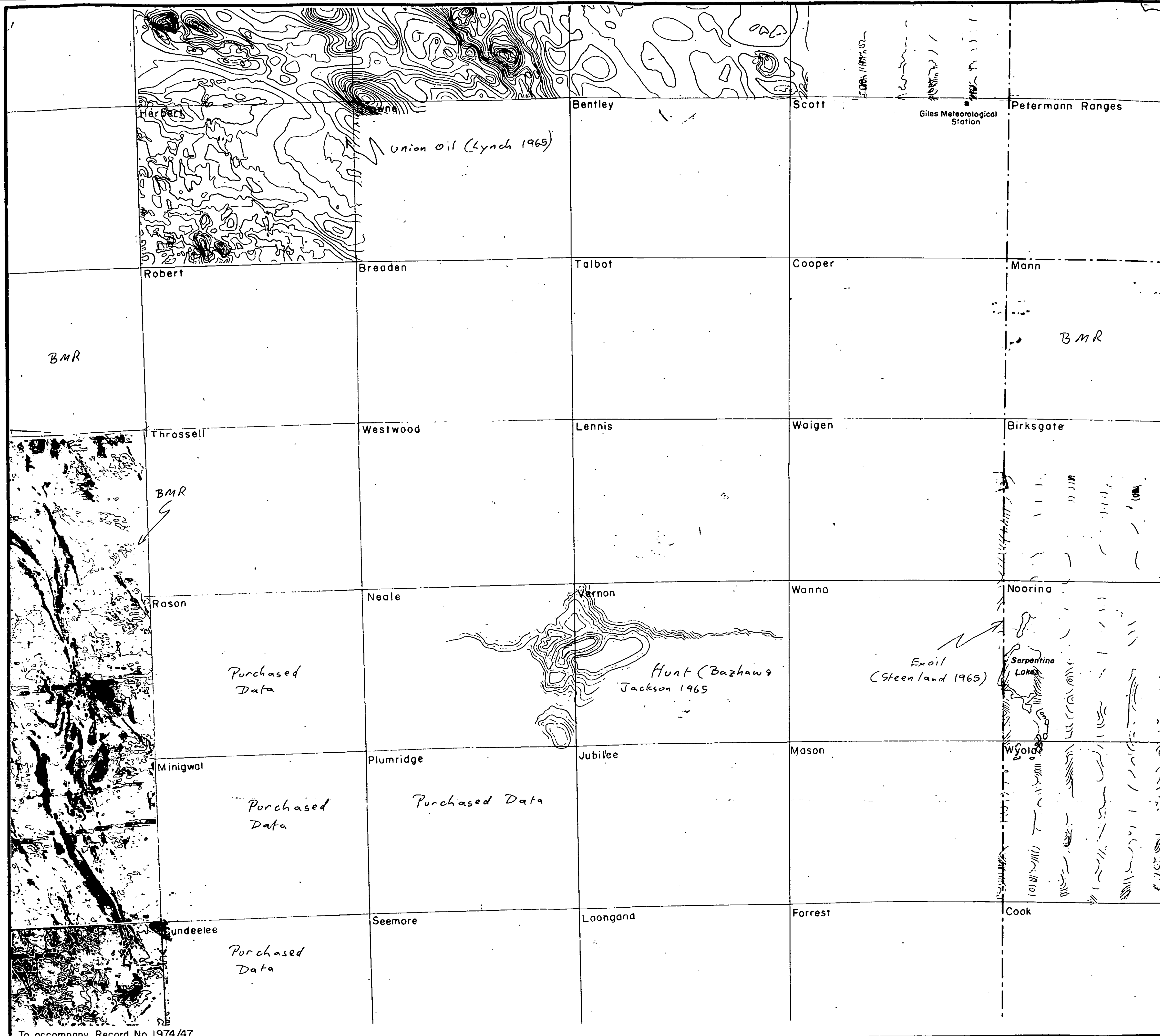
SCALE

0 50 100 150 km.

0 50 100 miles

PLATE 11

G52/BI-52



To accompany Record No. 1974/47

OFFICER BASIN AEROMAGNETIC SURVEY

TOTAL MAGNETIC INTENSITY CONTOURS

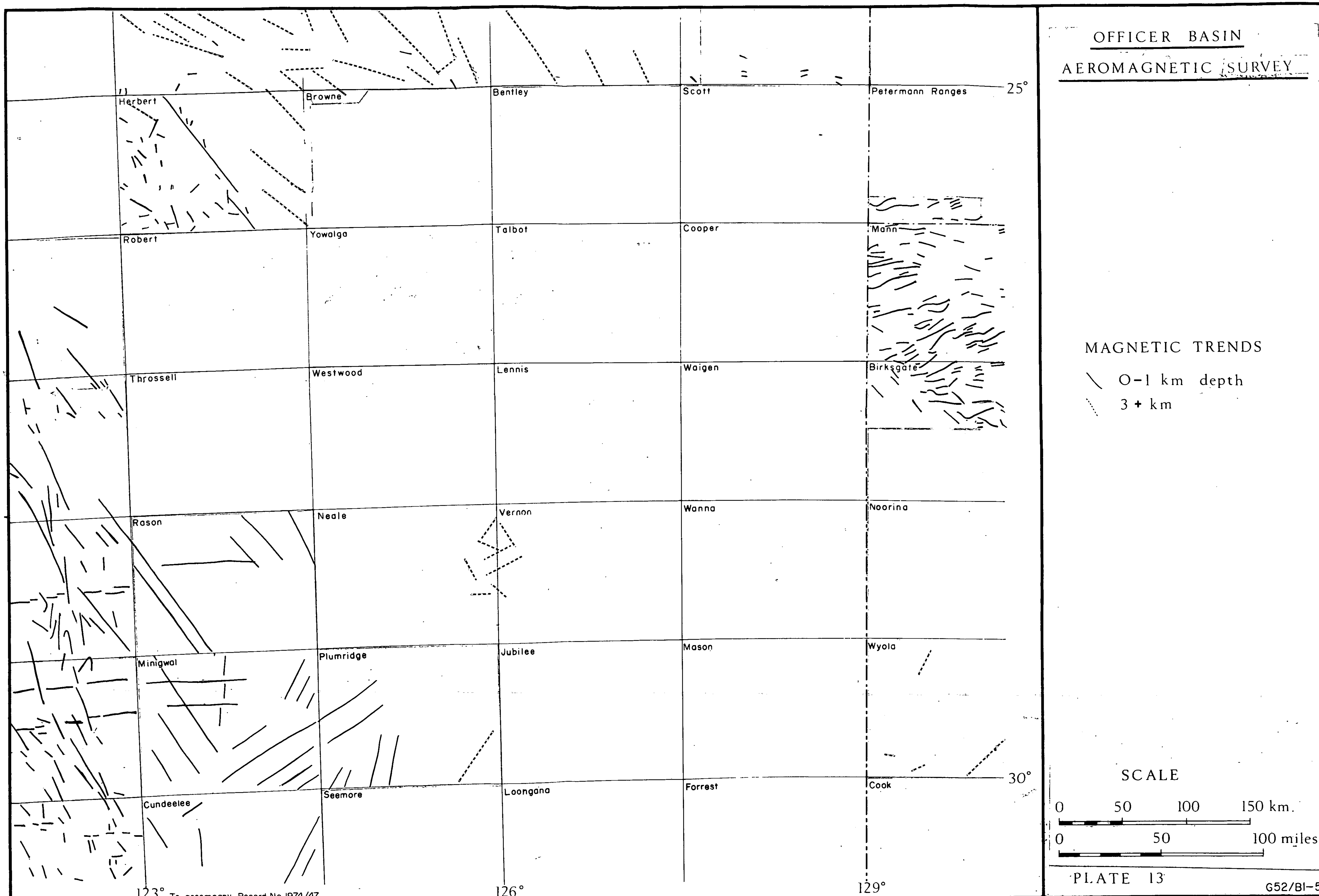
SCALE

0 50 100 150 km.

0 50 100 miles

PLATE 12

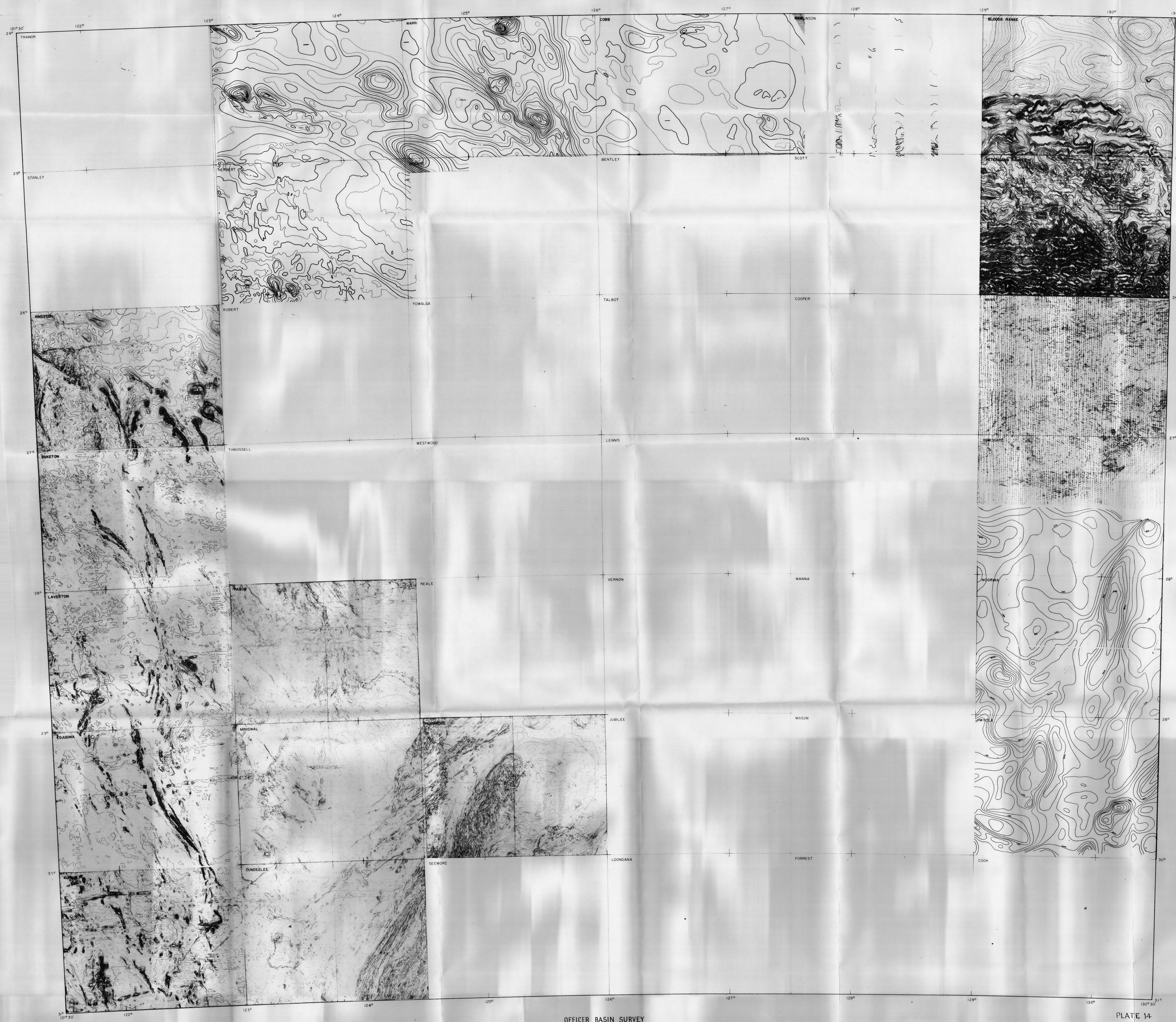
G52/BI-53



To accompany Record No. 1974/47

PLATE 13

G52/B1-51

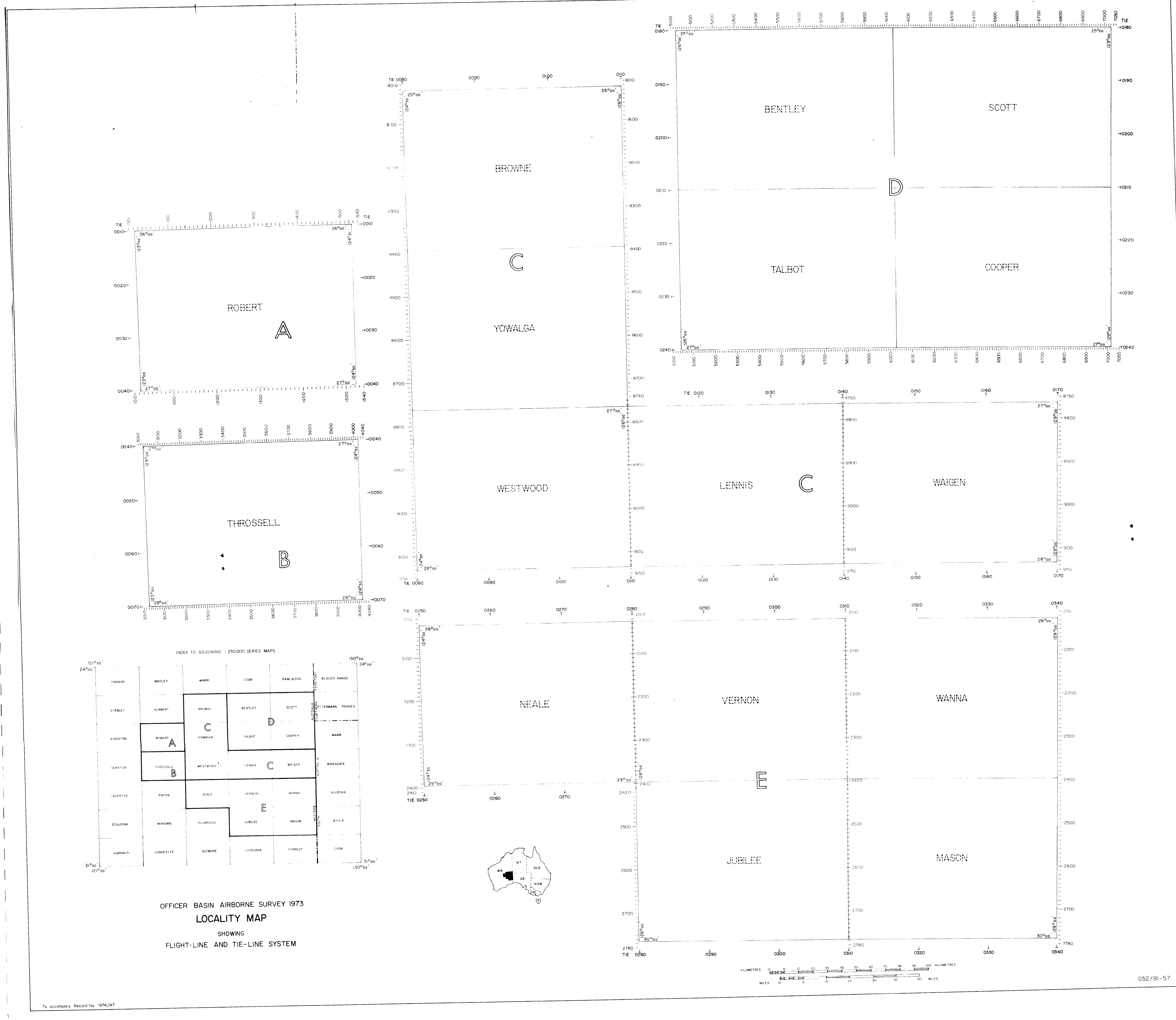


OFFICER BASIN SURVEY
T.M.I. CONTOURS
Scale 1:1,000,000

PLATE 14

To accompany Record No. 1974/47

Not for publication G51/B1-59



OFFICER BASIN AIRBORNE SURVEY 1973

LOCALITY MAP

SHOWING

FLIGHT-LINE AND TIE-LINE SYSTEM

To accompany Record No. 1974/47